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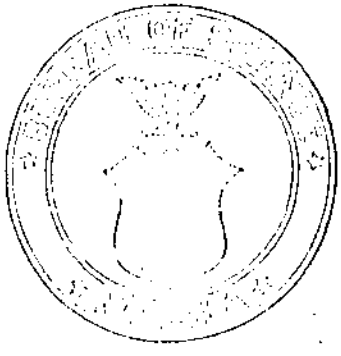

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MILLABLE CANE IN THE PHILIPPINE ISLANDS

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ONE PLATE

In the Philippine Islands it frequently happens that cane of very low purity is sent to the factory. The actual cause of such low purity is of little importance to the manufacturer or the contracting planter. Often, however, the cane is so low in purity that it cannot be ground without loss to the central, and sometimes to both the central and the planter. When both are equal losers no controversy may arise, but if only the central is the loser a means should be devised by which it can refuse such cane.

Sometimes, when there is excellent planting weather, it may be advantageous to the planter to plant for his next crop, even though the mill cannot immediately handle the cane which furnishes the points; so that it often happens that the cane, having been cut for seed, remains in the field and starts its second growth, thus decreasing in purity. Should the cane be accidentally burned the purity would also be decreased, and in either case the material coming to the mill would be unfit for grinding. If such low-purity cane were milled separately, the rendement might be ascertained and the planter who furnished cane of a better class would not suffer. In actual practice, however, such separate milling cannot always be done; consequently, no stimulus is given for the production of better cane, and the result is that both the planter of the high grade and the central suffer considerable loss at the hands of the producer of low-grade cane. If the planter were willing to allow the factory to refuse his low-

purity cane no loss might be entailed; but, should he insist upon its being milled on the contract basis, it must be ground, since the usual contract contains no proviso for the refusal of poor cane. The manufacturer must proceed with the work, even though he knows the cane to be poor. Obviously it would be to the advantage of all if a fair standard of purity were established, to serve as a basis for determining whether cane may be considered millable or not.

Cane, to be considered millable from the standpoint of the central, should be of such sucrose content and purity that the central can work it into sugar and molasses with the equipment on hand, without being compelled to resort to remelting, special processes, or the purchase of extra machinery. From juices extracted from millable cane it should be possible to produce 96° sugar or better, and a molasses showing an average purity. Obviously cane showing a purity of only 60 per cent for the mixed juice will not, by itself, produce in one operation a standard 96° sugar; the sugar resulting after leaving the crystallizer and the centrifugals will have to be remelted or, if a good grade is obtained, it will at least have to be mixed with a higher-grade molasses for further conversion into a standard centrifugal sugar. This procedure not only complicates the work, but also increases the cost of manufacture and, therefore, reduces the profits to the central.

In determining a fair standard for millable cane the purity of the juice is not the sole factor to be taken into consideration. For example, a juice with a Brix of 10° and a purity of 80 per cent will give a rendement of 5.76 per cent, while a juice with a Brix of 15° and the same purity, will give a rendement of 8.66 per cent. Both juices mentioned are equally millable. However, the cost of transportation of the cane per ton of sugar is much greater in the first case than in the second, and the steam consumption for evaporation of the first juice is considerably greater. Therefore, there should be adopted also a minimum for the degrees Brix.

A modern factory making a 96° sugar will adopt the three-boiling system, this being the most economical and the easiest. The purities maintained will be: for the first boiling, 80 per cent; for the second, 70; and for the third, 60. These purities are obtained by boiling straight sirup to grain, and then adding molasses from former strikes so as to obtain the required purities in the finished massecuites. The purity of the sirup should not fall below 70 per cent. I am fully aware that, as

a rule, a cane of such low purity will not come to the mills; however, I have seen cane come to the central the first mill juice of which was of 38 per cent purity. This was badly burned cane which had been left in the field for a month. When the sirup has a purity of 70 per cent, the first boiling is omitted and only the two-boiling system is employed. By washing we can then obtain a 96° sugar from the resulting massecuite. Generally, where the purity drops below 70 per cent, the massecuite will not produce a good 96° sugar and the product will have to be remelted which will require the use of extra pan capacity and entail extra cost. I have adopted as a basis the minima of 15° and 70 per cent, respectively, for Brix and purity.

The available sugar in a ton of cane is then 6.97 per cent and it takes 14.35 tons of cane to make a ton of sugar. From the manufacturing standpoint alone such a cane can be handled; however, financially it may be undesirable to handle. In this connection the following items to be considered are enumerated:

1. Cost of transportation per ton of cane.
2. Cost of manufacture per ton of sugar.
3. At lower rendement, extra cost for items 1 and 2.
4. Overhead charges per day.
5. Capacity of mill or tons of cane ground per day.

Allowing a central or a plantation company a net profit of 40 per cent over the cost of manufacture, I have worked all these items into the following formula:

$$1.4\ (10t + C + x\ [t + 1.20] + \frac{O}{\frac{Cap.}{10 + x}}) = \tfrac{1}{2}\ P.$$

t= Cost of transportation per ton of cane.
C= Cost of manufacture per ton of sugar.
O= Overhead charges per day.
Cap.= Capacity of mill or tons of cane ground per day.
P= Net proceeds at marketing place of the sugar.

In the formula, I have added 1.20 pesos to the manufacturing cost for every ton of cane over 10 required to make a ton of sugar. The mean higher cost of manufacture comes to this figure, calculated from actual data that I have on record.

Assuming the following data:

t= 50 centavos,
C= 20 pesos, at 10 to 1,
O= 300 pesos,
Cap.= 600 tons,
P= 140 pesos per ton of sugar,

and applying these figures to the formula, leaving x unknown we get $x=9$. This means that it may take 9 more than 10 tons, or 19 tons, of cane per ton of sugar, without reducing the net profit—namely 40 per cent.

For different net proceeds ranging from 80 pesos to 220 pesos, Table 1 shows the amount of cane (in tons) that mills of various capacities may require in order to make the stipulated profit. The capacities range from 150 to 600 tons per day.

TABLE 1.—*Number of tons of cane necessary to obtain net proceeds of from 80 to 220 pesos in mills of from 150 to 600 tons per day capacity.*

Capacity.	Net proceeds in pesos.							
	80	90	100	110	120	130	140	150
Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
150	5.56	6.53	7.49	8.46	9.43	10.39	11.35	12.30
200	6.43	7.55	8.66	9.78	10.89	12.01	13.13	14.25
250	7.10	8.33	9.60	10.79	12.02	13.25	14.48	15.71
300	7.62	8.94	10.26	11.59	12.92	14.25	15.58	16.91
350	8.05	9.44	10.84	12.24	13.64	15.04	16.44	17.84
400	8.40	9.86	11.31	12.76	14.21	15.66	17.11	18.56
450	8.68	10.18	11.68	13.18	14.68	16.18	17.68	19.18
500	8.94	10.49	12.04	13.59	15.14	10.69	18.24	19.79
550	9.16	10.75	12.34	13.93	15.52	17.11	18.70	20.29
600	9.8	11.0	12.5	14.2	15.8	17.4	19.0	20.7

Capacity.	Net proceeds in pesos.						
	160	170	180	190	200	210	220
Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
150	13.26	14.20	15.17	16.12	17.08	18.03	18.99
200	15.37	16.49	17.61	18.73	19.85	20.97	22.09
250	16.94	18.17	19.40	20.66	21.86	23.09	24.32
300	18.24	19.57	20.9	22.23	23.56	24.89	26.22
350	19.24	20.64	22.04	23.44	24.84	26.24	27.64
400	20.01	21.46	22.91	24.36	25.81	27.26	28.71
450	20.68	22.18	23.68	25.18	26.68	28.18	29.68
500	21.34	22.89	34.44	25.99	27.54	29.09	30.64
550	21.88	23.47	25.06	26.65	28.24	29.83	31.42
600	22.3	24.0	25.6	27.2	28.8	30.4	32.00

For a factory working at full capacity the rendement allowable depends upon the net proceeds from the sugar. However, there is the possibility that a factory cannot be run continually at full capacity, owing to various causes; such as a breakdown in the mill, rains, lack of labor, transportation difficulties, and fires. If for any of these reasons the capacity is cut in half, by again using the formula but now adopting 300 tons as ca-

pacity, the allowable rendement will be shown to be 15.58 tons against 19 tons as before. The figure of 15.58 is dangerously near the minimum set, namely, 14.35 tons of cane per ton of sugar. The formula also permits the manufacturer to calculate the minimum quantity of a certain cane that must be milled per day in order to make the set profit. Thus the question whether grinding should or should not proceed depends upon net proceeds and capacity (the amount of cane ground in twenty-four hours) ; and these two factors, namely, net proceeds and capacity, control the rendement allowable. The smaller the capacity of the central, or the smaller the quantity of cane ground per day in a central of any capacity, the higher the rendement must be. For instance, Tables 1 and 2 show that, if the juice has 15° Brix and a purity of 70 per cent, at least 245 tons will have to be ground daily in order to make the stipulated 40 per cent profit. Any manufacturer can calculate from this formula whether or not he can grind profitably under conditions as they exist in his central. The graphic chart (Plate 1) shows the figures much more plainly than does the table.

This chart is useful in many ways. Assuming that the net proceeds per ton of sugar amount to 140 pesos and that the capacity of the central is 600 tons of cane, the lines indicating these numbers cross at 19, showing that this is the number of tons of cane it will take to make 1 ton of sugar in order to clear the stipulated 40 per cent profit. Assuming the net proceeds and the rendement of the cane to be 160 pesos and 12 tons, respectively, we find that the line on the chart showing the lowest capacity is still well above the crossing of these two lines; which means that, if the mill grinds even less than 150 tons of cane per day, it can still make the 40 per cent profit. On the other hand, with net proceeds of 140 pesos and a rendement of 14 tons, milling would have to be done at a rate of about 250 tons; with 130 pesos and 14 tons rendement, 300 tons; and with the same net proceeds and 15 tons rendement, it must grind at least 350 tons per day. In other words, the poorer the cane the faster must grinding be done. Up to a certain point this can be regulated in actual practice since mill capacity, depending as it does upon the size of the boiling house, is fairly elastic. If the boiling house is slightly larger than is specified by the capacity of the mill, a decided advantage is gained.

As far as establishing a standard for purity is concerned it is clear that it is possible to grind a cane of a purity lower than 70 per cent, since the higher-grade cane coming in at the same

time offsets this low purity; but mixed grinding can be done only to a certain extent, as such a procedure would tend to overfill the boiling house with low-grade sugar products, while the crystallizer capacity would soon be exceeded. However, the amount of low-grade sugar produced will be the same in the end whether the low-purity juice comes in mixed with the better juice or separate. If two cane fields are being cut at the same time, the cane from the one showing a high-purity juice, and that from the other a low-purity juice, both canes will have to be accepted by the central, so long as the mean purity does not fall below 70 per cent. It is not advisable to grind cane giving a 70 per cent purity for, say, one week and then to begin grinding cane of a higher purity, because the great number of lower boilings might keep the crystallizers and centrifugals occupied so long that the working of the factory would be blocked. Many modern centrals provide crystallizers only, but no special tanks for low-grade blank strikes. Under ordinary circumstances special tanks will not be needed, but when a large quantity of low-purity juice comes to a factory it will prove an advantage to have them; for then good sirup will not need to be mixed with molasses from a poor juice which usually not only is low in purity, but also is hard to handle mechanically.

The molasses from a poor juice is simply brought to string proof and sent to the massecuite storage tanks, each tank holding one strike. These storage tanks are continually kept filled until a holiday occurs, or until the end of the grinding season; then they are emptied, the massecuite is spun, and the resulting low-grade sugar is remelted.

The foregoing remarks serve to lead up to the question of what should be done with cane of low purity. Almost invariably the planter who has his cane milled by the central on a percentage basis thinks that he should derive a certain profit from it. I well remember one instance when cane came to the factory that gave a first mill juice of 38 per cent purity. This was an extreme case, which would undoubtedly happen but once in a lifetime. But when cane with a purity of from 55 to 65 per cent comes to the mill day after day, with only a very small quantity of good cane to offset it, the question arises whether the central may refuse to mill such cane or whether some use cannot be found for it which might offset the loss that undoubtedly would occur in milling it for sugar. So far as I know, there is at present in the Philippines no central that allows the

planter an interest in the molasses, and the peculiar fact exists that a very poor cane will only pay for its transportation when converted into molasses. In fact it will pay for its transportation more readily than good cane, naturally assuming that the molasses is sold. In Table 2, I have put this fact in figures which are self-explanatory.

TABLE 2.—*Showing values gained from the utilization of juice for the manufacture of molasses* [a] *and of alcohol.* [b]

Brix.	Value of alcohol per ton of sugar.	Average rendement molasses.	Cane per ton of sugar.	Transportation cost per ton of sugar.	Molasses per ton of sugar.	Value of molasses per ton of cane.	Value of molasses per ton of sugar.	Available 180° alcohol per ton of cane.	180° proof alcohol per ton of cane.	Value of alcohol per ton of cane.
	Pesos.	*P. ct.*	*Tons.*	*Pesos.*	*Lbs.*	*Pesos.*	*Pesos.*	*P. ct.*	*Lbs.*	*Pesos.*
70 PER CENT PURITY.										
15	49.22	5.32	14.33	7.17	106	0.53	7.60	1.18	23.6	3.43
16	52.57	6.04	13.48	6.74	121	0.605	8.15	1.34	26.8	3.90
17	52.28	6.37	12.69	6.34	127	0.635	8.05	1.41	28.2	4.12
18	53.80	6.89	11.93	5.96	138	0.690	8.23	1.53	30.6	4.45
19	52.25	7.17	11.31	5.65	143	0.715	8.08	1.59	31.8	4.62
20	56.26	7.54	10.77	5.38	150	0.750	8.08	1.67	33.4	4.85
21	52.48	7.92	10.27	5.13	158	0.790	8.11	1.76	35.2	5.11
22	52.21	8.30	9.76	4.88	166	0.830	8.10	1.84	36.8	5.35
80 PER CENT PURITY.										
15	24.25	3.57	11.55	5.77	71	0.35	4.16	0.79	15.8	2.30
16	26.47	3.80	10.85	5.42	76	0.38	4.12	0.84	16.8	2.44
17	26.34	4.03	10.21	5.10	80	0.40	4.08	0.89	17.8	2.53
18	26.28	4.26	9.63	4.81	85	0.42	4.18	0.94	18.8	2.73
19	26.59	4.50	9.14	4.57	90	0.45	4.09	1.00	20.0	2.91
20	26.41	4.73	8.66	4.33	95	0.47	4.06	1.05	21.0	3.05
21	26.40	4.96	8.26	4.13	99	0.50	4.05	1.10	22.0	3.20
22	26.43	5.19	7.89	3.94	104	0.52	4.09	1.15	23.0	3.35
90 PER CENT PURITY.										
15	9.29	1.47	9.68	4.84	29	0.14	1.35	0.33	6.6	0.96
16	9.25	1.57	9.07	4.53	31	0.15	1.36	0.35	7.0	1.62
17	9.14	1.67	8.54	4.27	33	0.16	1.37	0.37	7.4	1.07
18	9.11	1.77	8.07	4.03	35	0.17	1.37	0.39	7.8	1.13
19	9.09	1.87	7.64	3.82	37	0.18	1.38	0.41	8.2	1.19
20	9.30	1.97	7.27	3.63	39	0.19	1.38	0.44	8.8	1.28
21	9.19	2.07	6.91	3.45	41	0.20	1.38	0.46	9.2	1.33
22	9.27	2.17	6.60	3.30	43	0.21	1.39	0.48	9.6	1.39

[a] Value of molasses per pound is 0.005 peso (0.06 peso a gallon; now, February, 1920, 0.80 peso; 1 gallon=12 pounds.)

[b] Value of alcohol per gallon is 1 peso; per pound, 0.1455 peso.

In the case of poor cane it is clear that the planter is the one who suffers most, as he gets no returns for raising, cutting, and loading it, while the factory can at least clear the cost of transportation. In fact, I should be inclined to consider whether it might not pay to work up poor cane for its molasses yield, rather than in the manufacture of sugar. Molasses would then become one of the main products, although still a by-product.

Naturally, when good cane is available, cane that yields juice of too low a purity should not be allowed to be milled together with the better grade, since it is almost impossible, under ordinary circumstances, to keep the juices separate. If the factory would decide to give the planter an interest in the molasses, or in any of the products made from molasses, such as alcohol, conditions would be greatly altered. The planter should be allowed an interest in the by-products, for the reason that molasses contains most of the soluble salts, of which potash forms about 2.5 per cent of the weight of the molasses. This potash is the most valuable constituent taken from the soil by the cane, and unless returned to it the soil becomes impoverished. When the molasses is burned in conjunction with the bagasse, most of the potash can be recovered, and this should be given to the planter for fertilization purposes. The planter should be required to pay the cost of loading and hauling. In practice much of the potash is lost, due to the fact that the furnace is maintained at too high a temperature, which fact is betrayed when the top of the smoke stack of the factory shows white.

In Table 2 are shown the values of the molasses when made into denatured alcohol, taking alcohol at 1 peso per gallon, or about 14 centavos per pound. The table also shows that a fair amount of money can be recovered from the molasses. As a rule, a well-equipped, modern central will be able to run its distillery without interfering with the operation of the boiling house and mill. There should be no lack of steam and, if the cane contains from 11.5 to 13 per cent of fiber, sufficient bagasse fuel should be on hand to run the distillery also. The table shows that the poorer the cane, the more valuable the molasses, the yields being as high as 53.80 pesos per ton of available sugar in one instance when expressed as alcohol, while the molasses itself represents a value of only about 8.23 pesos when sold as such at 6 centavos per gallon. If we take 12 centavos as the value of the molasses per gallon, a ton of available sugar would yield in molasses only 16.46 pesos, or 37.34 pesos less per ton of sugar when sold as molasses than when sold as alcohol.

In the process of manufacturing alcohol from molasses the waste from the distillery still contains potash, as well as nitrogen and phosphoric acid, which can be returned to the field, either in liquid form by irrigation or in solid form after drying the material in the sun.

Assuming a factory production of 10,000 tons of sugar per year from a juice with 19° Brix and 80 per cent purity, the molasses produced would be 4.5 per cent of the weight of the cane. Therefore, assuming the potash content of the molasses to be 2.5 per cent, the potash would represent (the cane weighing 91,400 tons) 102.825 tons with a value of about 200 pesos per ton (pre-war price), or a total value for the crop of 20,565 pesos. The alcohol would be worth 205,900 pesos; the sugar at say 200 pesos per ton, 2,000,000 pesos; total value of the crop, 2,286,465 pesos. If the molasses were sold as such, we should have:

	Pesos.
Value of crop at 200 pesos per ton	2,000,000
Value of molasses	40,900
Total value	2,040,900

Therefore, the difference in value is 245,565 pesos in favor of working up the molasses into alcohol and potash. In this case I have calculated values at pre-war market prices. Each factory can figure out for itself whether or not it would pay to work up this material. As I have pointed out in another paper, not yet in print, the alcohol could be used in tractors or motors on the plantation; and the carbon dioxide coming from the fermentation vats could be employed in making plantation white sugar and, where there is access to cool well water, in making ice. The value of the potash is a paper value, since it should be returned to the field as a fertilizer, so as to keep the field in proper condition.

If the molasses is converted into alcohol so little of the former will be wasted that I cannot see how this use of it could fail to yield an excellent profit, and the question of profitable utilization of low-purity cane would seem to be answered.

For convenience I am adding Table 3, showing values at the same purities as in Table 2, giving approximate values of the potash per ton of cane at 200 pesos per ton for the potash.

In Table 4 are given values per hectare (the crop estimated at 50 tons of cane per hectare), showing the difference in value when the product is sold as sugar and molasses, as is done now, and its value when sold as sugar, alcohol, and potash. With a

juice of 18.5° Brix and 85 per cent purity the central now receives 15.25 pesos per hectare for the molasses against 114.90 pesos per hectare when worked up into alcohol and potash.

In conclusion, it seems to me feasible to install a central distillery capable of working up all the molasses produced, and to give the planter an opportunity to own a half interest. Even under such conditions the central will net more than under the present way of working up the molasses, or by selling it direct.

TABLE 3.—*Approximate values of potash per ton of cane yielding juices of varying purity.*

Brix.	Molasses rendement.	Potash rendement.	Potash.	Value.
	Per cent.	*Per cent.*	*Lbs.*	*Pesos.*
PURITY, 70 PER CENT.				
15	5.32	0.133	2.66	0.532
16	6.04	0.151	3.02	0.604
17	6.37	0.159	3.18	0.636
18	6.89	0.172	3.44	0.688
19	7.17	0.179	3.58	0.716
20	7.54	0.188	3.76	0.752
21	7.92	0.198	3.96	0.792
22	8.30	0.207	4.14	0.828
PURITY, 80 PER CENT.				
15	3.57	0.089	1.78	0.356
16	3.80	0.095	1.90	0.380
17	4.03	0.101	2.02	0.404
18	4.26	0.106	2.12	0.424
19	4.50	0.112	2.24	0.448
20	4.73	0.118	2.36	0.472
21	4.96	0.124	2.48	0.496
22	5.19	0.129	2.58	0.516
PURITY, 90 PER CENT.				
15	1.47	0.037	0.74	0.148
16	1.57	0.039	0.78	0.156
17	1.67	0.041	0.82	0.164
18	1.77	0.044	0.88	0.176
19	1.87	0.046	0.92	0.184
20	1.97	0.049	0.98	0.196
21	2.07	0.052	1.04	0.208
22	2.17	0.054	1.08	0.216

TABLE 4.—*Values of product when sold as sugar and molasses and when sold as sugar, alcohol, and potash, based on an estimated crop of 50 tons of cane per hectare.*[a]

PURITY, 70 PER CENT.

Brix.	Sugar.	Value of sugar.	Value of molasses.	Value of alcohol.	Value of potash.	Total value of sugar and molasses.	Total value of sugar, alcohol, and potash.
	Tons.	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*	*Pesos.*
15	3.484	696.80	26.50	171.50	16.60	723.30	884.90
16	3.709	741.80	30.25	195.00	24.20	772.05	961.00
17	3.941	788.20	31.75	206.00	31.80	819.95	1,026.00
18	4.191	838.20	34.50	252.50	34.40	872.70	1,095.10
19	4.422	884.40	35.75	231.00	35.80	920.15	1,151.20
20	4.646	929.20	37.50	242.50	37.60	966.70	1,205.30
21	4.869	973.80	39.50	255.50	39.60	1,013.30	1,268.90
22	5.123	1,024.60	41.50	268.50	41.40	1,066.10	1,334.50
Mean						896.42	1,123.15
PURITY, 80 PER CENT.							
15	4.322	864.40	17.50	115.00	17.80	881.90	997.20
16	4.609	921.80	19.00	122.00	19.00	940.80	1,062.80
17	4.896	979.20	20.00	129.00	20.20	999.20	1,128.40
18	5.192	1,038.40	21.00	136.50	21.20	1,059.40	1,196.10
19	5.470	1,094.00	22.50	145.50	22.40	1,116.50	1,261.90
20	5.772	1,154.40	23.50	152.50	23.60	1,177.90	1,330.50
21	6.054	1,210.80	25.00	160.00	24.80	1,235.80	1,395.60
22	6.336	1,267.20	26.00	167.50	25.80	1,293.20	1,460.50
Mean						1,087.95	1,229.00
PURITY, 90 PER CENT.							
15	5.165	1,038.00	7.00	48.00	7.40	1,040.00	1,088.40
16	5.513	1,102.60	7.50	51.00	7.80	1,110.40	1,161.40
17	5.855	1,171.00	8.00	53.50	8.20	1,179.00	1,232.70
18	6.196	1,239.20	8.50	56.50	8.80	1,247.70	1,304.50
19	6.544	1,308.80	9.00	59.50	9.20	1,317.80	1,377.50
20	6.878	1,375.60	9.50	64.00	9.80	1,385.10	1,449.40
21	7.236	1,447.20	10.00	66.50	10.40	1,457.20	1,524.10
22	7.575	1,515.00	10.50	69.50	10.80	1,525.50	1,595.80
Mean						1,282.75	1,341.00

[a] Ton of sugar, value 200 pesos; ton of potash, value 200 pesos; 1 gallon of 180° denatured alcohol, value 1 peso. Total difference for a cane giving a juice with Brix of 18.5° and purity of 85 per cent when the product is sold as sugar and molasses and when it is sold as sugar, alcohol, and potash is 99.65 pesos per hectare.

ILLUSTRATION

PLATE 1. Chart showing relationship between rendement, net proceeds, and capacity.

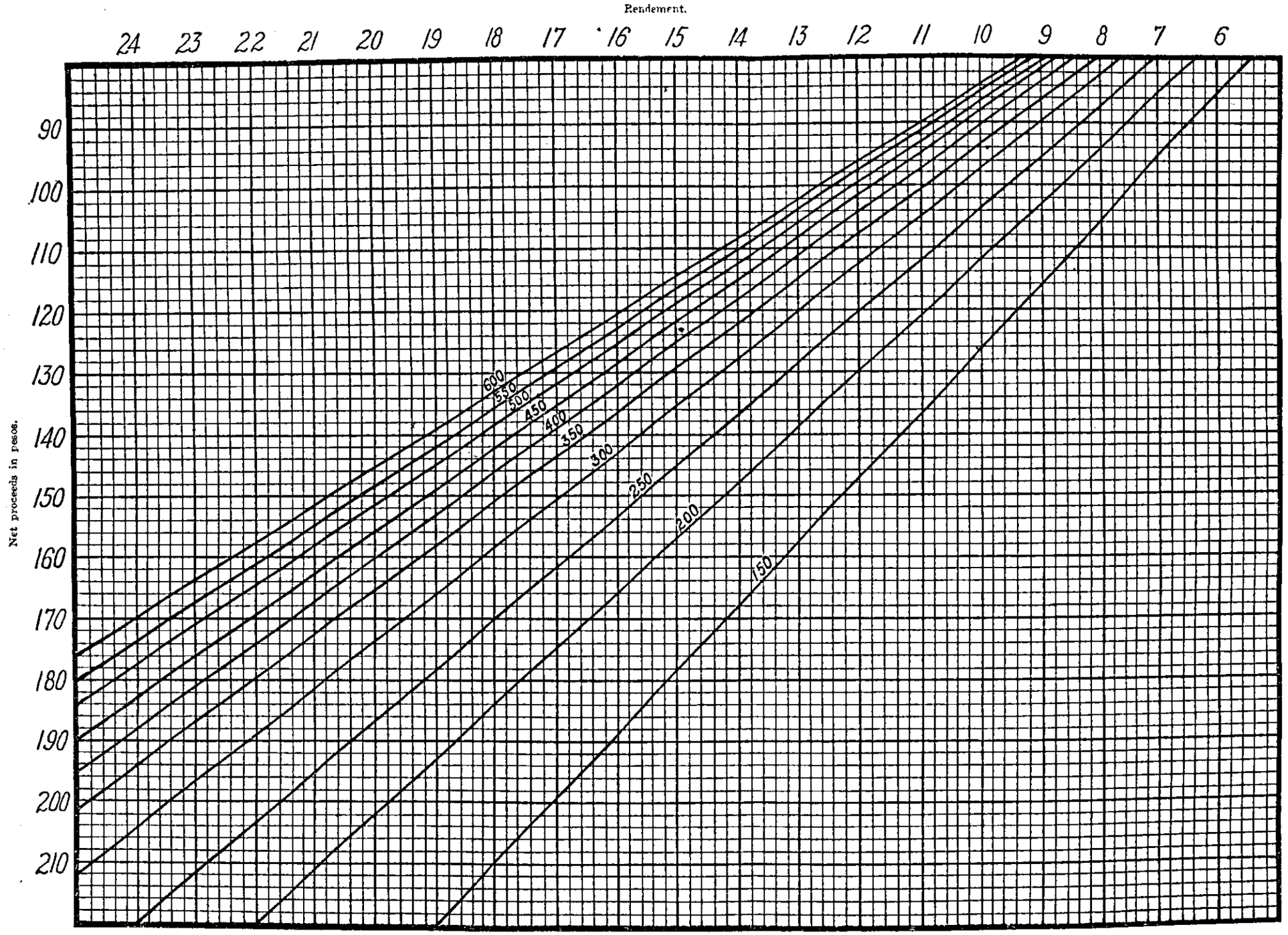

PLATE 1. SHOWING RELATIONSHIP BETWEEN RENDEMENT, NET PROCEEDS, AND CAPACITY.

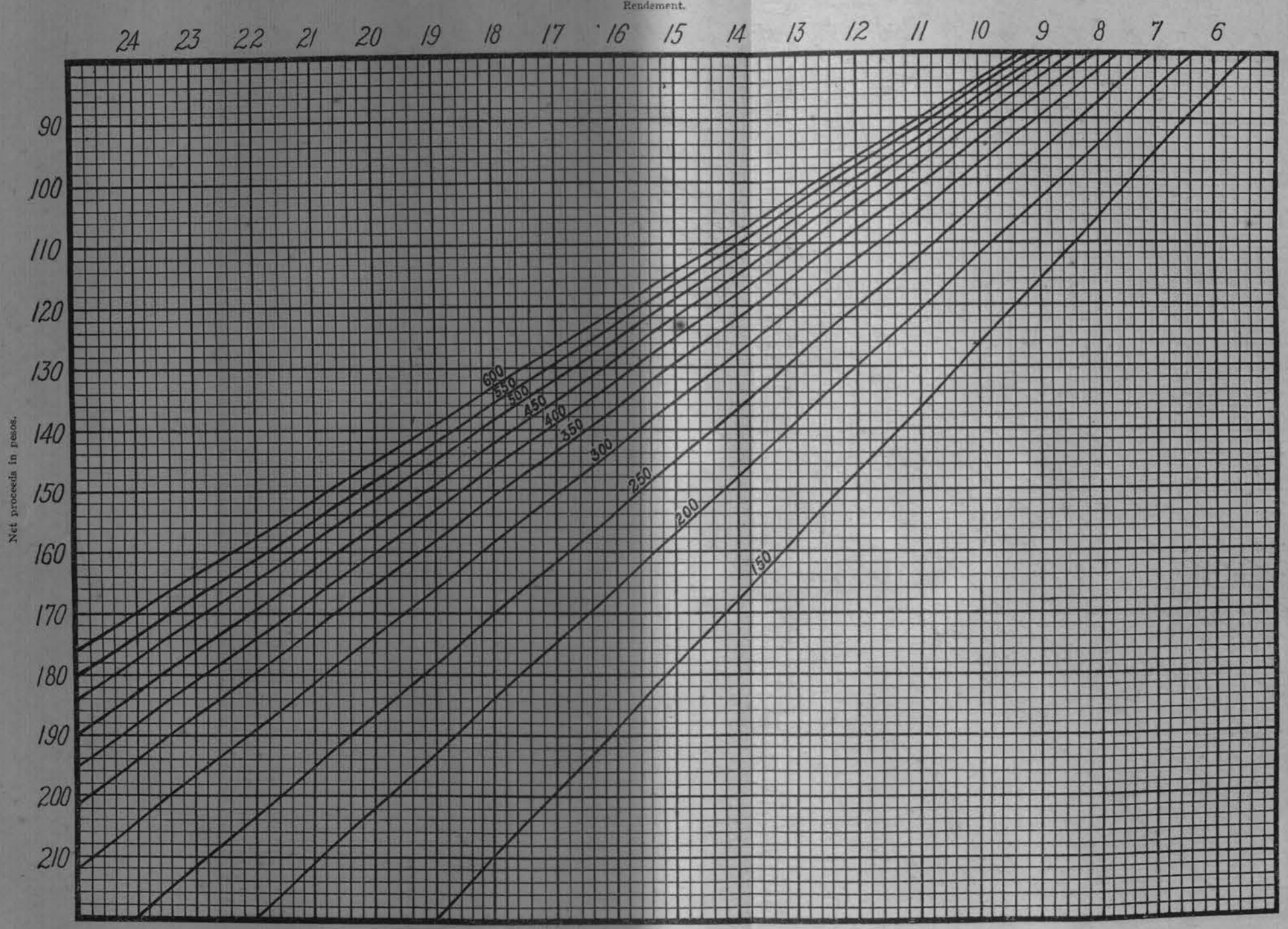

PLATE 1. SHOWING RELATIONSHIP BETWEEN RENDEMENT, NET PROCEEDS, AND CAPACITY.

THE NONDIASPINE COCCIDÆ OF THE PHILIPPINE ISLANDS, WITH DESCRIPTIONS OF APPARENTLY NEW SPECIES [1]

By Harold Morrison

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ONE PLATE AND FORTY TEXT FIGURES

Under the title Coccidæ of the Philippine Islands,[2] Miss Elizabeth Robinson published in 1917 an account of the species of the Coccidæ then known from the Islands, and described some new species in the family, subfamily Diaspinæ. In the meantime and subsequently I have received or obtained a considerable number of lots of material of the nondiaspine subfamilies for study, mostly through sendings of specimens for determination to Dr. L. O. Howard, chief of the Bureau of Entomology; and I have also worked over the specimens from the Philippines now in the United States National collection of Coccidæ with the result that a number of species have been added to the list hitherto known from the Philippines, and through the opportunity for examining type specimens of a number of the species, different conclusions from those of Miss Robinson in regard to the identity of several of the species listed by her have been reached. In view of the large amount of material examined and the changes in synonymy and identity noted, it has been considered advisable to prepare a paper covering the nondiaspine species of the family in their entirety, even where no new information is added to that given by Miss Robinson. This paper is supplementary to hers to the extent that no host or distribution records given by her are repeated.

I am indebted to Prof. T. D. A. Cockerell, Mr. D. B. Mackie, Mr. R. C. McGregor, Prof. C. F. Baker, Mr. Geo. Compere, and, through the Director of the Philippine Bureau of Science, Prof. C. S. Banks for material for study from the Islands. No effort

[1] Published with the permission of the Secretary, United States Department of Agriculture.

[2] Philip. Journ. Sci. § D 12 (1917) 1–47, pls. 1–6.

has been made to check the localities listed exactly, but it is believed that most of the specimens are from Luzon. The data regarding the host, date of collection, locality, and name of collector have been copied, so far as possible, exactly as given with the different lots of material.[3]

The specimens have been prepared for microscopic study largely by Misses B. M. Boss and Sadie Keen, employees of the Bureau of Entomology. The drawings illustrating the structural characteristics of the species have been prepared by Emily Morrison, who also aided in the preparation of the photographic illustrations and in many other ways. To these I am correspondingly indebted.

Although obviously unsatisfactory in a number of ways, the system of classification outlined by Fernald[4] has been followed, except in a few unimportant details.

Unless some statement to the contrary is made, all of the identification keys which follow in this paper are based on the adult female of each species.

Key to the Philippine subfamilies of the Coccidæ.

a^1. Abdomen not terminating in a compound segment or pygidium; body naked or covered by secretion or a sac, not by a firm waxy scale separable from the insect; legs and antennæ usually, but not always present.

b^1. Anal opening at the apex of prominent dorsal lobe, with a spiniform organ between it and a pair of spiracular processes; anal ring with setæ; legs wanting; antennæ rudimentary; body inclosed in a resinous cell with three orifices (cf. *Ceroplastes*). **Tachardiinæ.**

b^2. Anal opening not so placed (on chitinized horn in *Ceroplastes*); body without spiniform organ or spiracular processes; not inclosed in a resinous cell with three orifices.

c^1. With two or more pairs of abdominal spiracles; anal ring without setæ, placed dorsally some distance before the body apex and not at the end of a cleft, circular, not covered by triangular plates; body usually thickly set with large hairs and circular gland pores..... **Monophlebinæ.**

c^2. Without abdominal spiracles; anal ring normally bearing setæ, placed at or close to the body apex or, if dorsally, at the anterior end of a cleft in the body.

[3] Some evident errors in names of localities have been corrected.—THE EDITORS.

[4] A Catalogue of the Coccidae of the world, Bull. Hatch Exp. Sta. Mass. Agr. College 88 (1903).

d^1. Body usually with the posterior extremity cleft, anal opening at the anterior end of this cleft and covered by a pair of triangular plates; these characters more or less obscured in the species that are covered with wax. ..... Coccinæ.

d^2. Posterior extremity of body not cleft, sometimes more or less indented; without plates over anal opening; body usually covered with cottony or mealy secretion or inclosed in a sac, rarely naked ..... Dactylopiinæ.

a^3. Abdomen terminating in a compound segment or pygidium; legs wanting; body covered by a firm waxy scale readily separable from the insect and made up in part of larval exuviæ..... Diaspinæ.[6]

MONOPHLEBINÆ

This subfamily is represented in the Philippines by species having the legs and antennæ well developed, the latter 8- to 11-segmented in the adult female, the body more or less covered dorsally with waxy, powdery, or cottony secretion, the anal ring dorsal and without setæ, the derm usually closely crowded with pores and hairs over practically the whole surface, and abdominal spiracles in all stages.

Key to the Philippine genera of the Monophlebinæ.

a^1. With not more than three pairs of abdominal spiracles; body hairs slender, tapering; adult female usually secreting a distinct elongated posterior ovisac (one exception)..... Icerya Sign.

a^2. With more than three pairs of abdominal spiracles; adult female with more or less waxy or mealy secretion, but without ovisac.

b^1. Dorsal body hairs stout, not tapering, bluntly rounded at apices; with seven pairs of abdominal spiracles..... Lophococcus Ckll.

b^2. Dorsal body hairs slender, tapering, acute at apices; adult female naked or more or less covered with mealy secretion dorsally; with seven pairs of abdominal spiracles..... Drosicha Walker.

In this subfamily a number of males, without females, have been described from the Philippines. Unfortunately it has not been possible to connect more than a single one of these with already described females, and as they are given in Miss Robinson's paper no further mention is made of any but the one which has been placed in synonymy.

Genus ICERYA Signoret

The usual, but superficial, distinguishing character of this genus is the development of a posterior ovisac in the adult fe-

[6] Not discussed in this paper.

male, but this is lacking in *Icerya jacobsoni* Green among those found in the Philippines. This species is evidently closely related to *Icerya* in its other characters, however, and, pending a revision of the genera of this subfamily, it is preferable to leave it here. In addition to the development of the ovisac, the Philippine species of the genus have 10- or 11-segmented antennæ in the adult female; three pairs of abdominal spiracles in all species except *I. purchasi,* which has two; and a more or less definite band of glands and hairs ventrally for secreting the ovisac.

Key to the Philippine species of Icerya.

a^1. Antennæ 10-segmented in adult female; without ovisac; with at least two types of gland pores, some, in clusters along the body margin, large, with trilocular centers and a projecting tongue.
I. jacobsoni Green.

a^2. Antennæ 11-segmented and ovisac developed in adult female; without gland pores with trilocular centers.

b^1. Derm gland pores of two types, one smaller, varying in size and arrangement, with solid center, the other much larger, ringlike, with large open center; marginal wax filaments of body not very long, dorsal secretion with numerous glassy threads through it.

c^1. With two pairs of abdominal spiracles; large open center gland pores along body margin only; body hairs numerous, conspicuously black; ovisac fluted..... I. purchasi Mask.

c^2. With three pairs of abdominal spiracles; large open center gland pores present on both dorsum and margins of body; body hairs dark reddish, not conspicuously black; ovisac smooth.
I. seychellarum (Westw.).

b^2. Derm gland pores of different sizes, but none so large as in preceding species, all with solid centers; body with a number of long, twisted, lateral and caudal filaments..... I. aegyptiaca (Dougl.).

Icerya jacobsoni Green.

Icerya jacobsoni Green, ROBINSON, Philip. Journ. Sci. § D 12 (1917) 2.

I have seen some of the material on which Miss Robinson based her record, and in addition have examined specimens collected at Los Baños, Laguna Province, on *Litsea glutinosa,* December 11, 1917 (*Banks 18353*) and at the same place on *Psidium guajava,* January, 1919 (*Baker 10098*). The specimens from Banks were as much as 9 millimeters long. The figure copied by Miss Robinson and the accompanying drawings of the structural details of the species should make it readily recognizable.

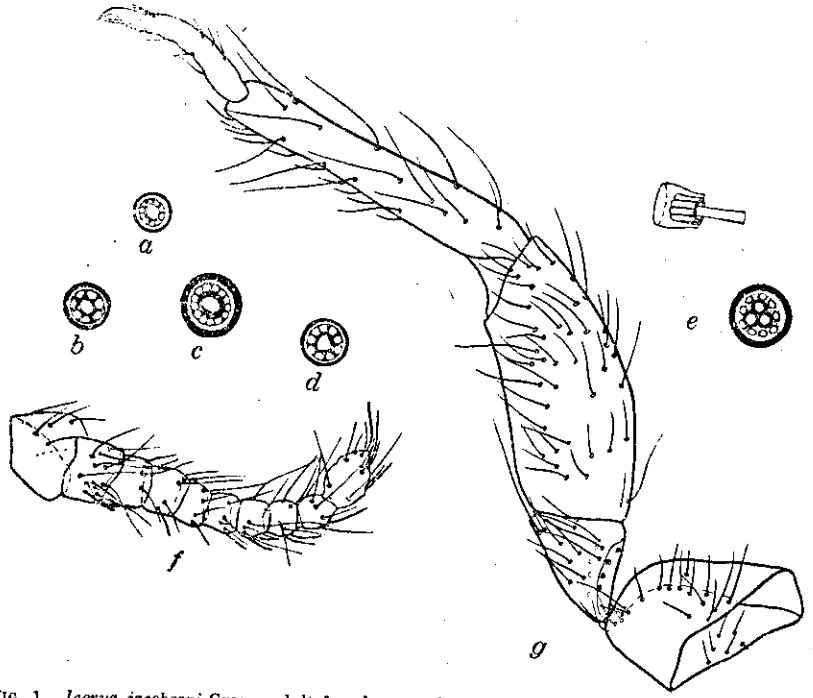

FIG. 1. *Icerya jacobsoni* Green, adult female; *a* to *d*, surface views of various sorts of circular wax gland pores found on body, × 640; *e*, surface view and section of trilocular center pores found in clusters along body margin, × 640; *f*, antenna, × 57.5; *g*, leg, × 57.5.

Icerya purchasi Mask.

Icerya purchasi MASKELL, Trans. New Zealand Inst. 11 (1878) 221.

FIG. 2. *Icerya purchasi* Mask., adult female, showing two types of gland pores, × 640.

I was much surprised when a few specimens of this species were located in the midst of a mass of *Drosicha townsendi* (Ckll.), and it seems very strange that it has not been collected again in Manila, but the material at hand has produced no other specimens of this species. Those found were from Manila "on various trees" (coll. *Compere*), and were collected in 1911.

Icerya seychellarum (Westw.). Plate I, fig. 2.

Icerya seychellarum (Westwood), ROBINSON, Philip. Journ. Sci. § D 12 (1917) 3.

Icerya candida COCKERELL, Proc. Dav. Acad. Sci. 10 (1905) 128.

A careful comparison of the type specimens of *Icerya candida* with a considerable amount of material of *I. seychellarum* fails to reveal any structural characters distinctive for the former

species, while it will be observed from a comparison of the original description of *candida* with those of *seychellarum* that there are no differences given with the exception of a few very slight ones in relative lengths of antennal segments and the differences in the color of the secretion covering the insect. Other writers have already noted the variation in the secretionary color

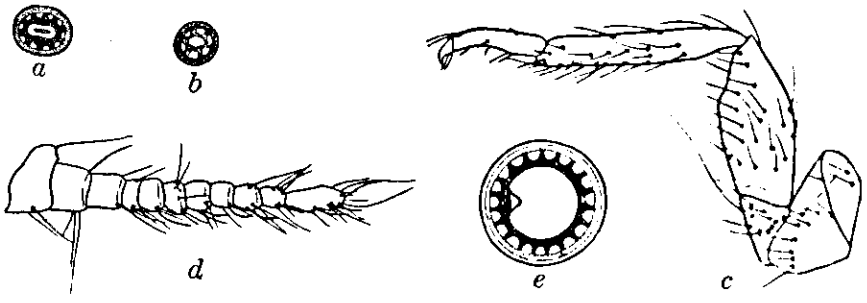

FIG. 3. *Icerya seychellarum* (Westw.), adult female; *a* and *b*, different sorts of solid-center gland pores on body, × 640; *c*, leg, × 57.5; *d*, antenna, × 57.5; *e*, large open-center gland pore, secreting glassy threads, × 640.

of *seychellarum*. The large gland pores with open centers and the presence of the numerous glassy threads in the secretion make this species easily recognizable.

In addition to the collection records given by Miss Robinson for the two species, the following may be cited:

LUZON, Manila, on *Artocarpus integrifolia* (coll. *P. J. Wester*), on *Citrus decumana* (coll. *B. Arce 2594*): Batangas Province, Tanauan, on *Citrus nobilis* (coll. *Wester*): Bulacan Province, Baliuag, on *Artocarpus integrifolia* (coll. *Arce 2614*): Quingua, on *Litsea glutinosa* (coll. *Arce 2616*): Laguna Province, Los Baños, on *Psidium guajava* (coll. *Banks 18453*), on *Streblus asper* (coll. *Baker 10093*).

Icerya aegyptiaca (Dougl.). Plate 1, fig. 1.

Crossotosoma aegyptiacum DOUGLAS, Ent. Month. Mag. 26 (1890) 79.
Icerya aegyptiacum (Dougl.), RILEY and HOWARD, Insect Life 3 (1890) 97.

This species does not appear to have been previously reported from the Philippine Islands, but the material sent by Mr. Mackie for determination gave the following records: Manila on *Barleria cristata* (coll. *Arce 2606*) and *Morus alba* (coll. *Arce 2568*). In addition it is known from Manila on *Citrus* (coll. *Compere*).

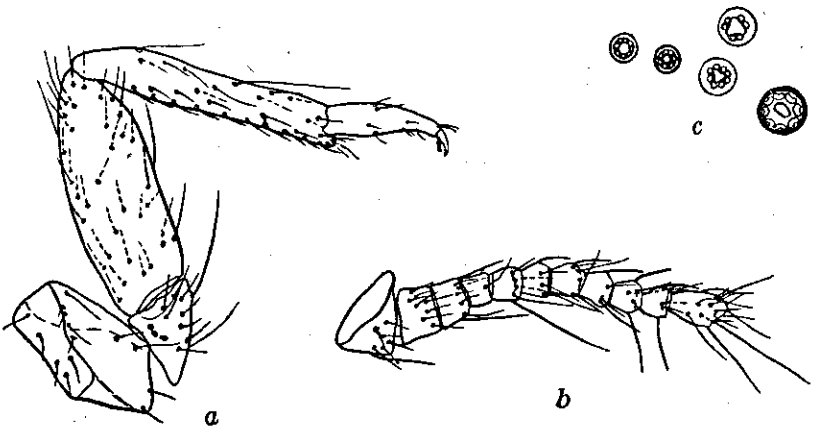

FIG. 4. *Icerya aegyptiaca* (Dougl.), adult female; *a*, leg, × 57.5; *b*, antenna, × 57.5; *c*, various sorts of gland pores present on body, × 640.

Genus LOPHOCOCCUS Cockerell [8]

A comparison of the following apparently new species with specimens in the United States National collection of Coccidæ identified as *Lophococcus mirabilis* Ckll. shows that the two are apparently congeneric.

Lophococcus convexus sp. nov.

Adult female.—Presumably occurring on the branches of the host; maximum length, 12.5 millimeters; maximum width, 9; maximum height, 7; oval, strongly convex, anterior apex truncate, posterior rounded; sides of body nearly perpendicular for two-thirds of its total height, this area terminated above by distinct and rather prominent lateral ridges about three-fourths as long as total length of body; with a broad, rounded longitudinal ridge, more convex medially, along median line dorsally; ventrally flat or somewhat concave; color dark reddish brown; body in life evidently covered by more or less mealy or waxy secretion, apparently only by a rather thin, more or less uniform coat which is easily rubbed off of the more prominent portions of the body; this view is borne out by the absence of any specially differentiated groups of gland pores or hairs dorsally, but the exact condition in life is not determinable from the preserved material.

[8] I do not desire to undertake any discussion regarding the possible identity or priority of *Lophococcus* Ckll., *Aspidoproctus* Newst., and *Walkeriana* Sign., as there is not sufficient material available for study to determine this question finally.

Body of female.—Antennæ short and stout, 10-segmented, measurements of one as follows: I, 125 μ; II, 104 μ; III, 96 μ; IV, 57 μ; V, 53 μ; VI, 62 μ; VII, 75 μ; VIII, 64 μ; IX, 57 μ; X, 164 μ; widest at the basal segment and tapering gradually from base to apex; legs stout but not large, the parts of a middle leg with the following measurements: Trochanter, 293 μ; femur, 589 μ; tibia, 632 μ; tarsus, 339 μ; claw, 96 μ; submentum apparently 1-segmented; with two pairs of thoracic and seven pairs of abdominal spiracles, the thoracic much larger, flattened, the abdominal small, short-tubular, surmounted by a collar of disk gland pores, somewhat constricted at junction of pores and chitinous portion of spiracle, thoracic spiracles placed ventrally, the abdominal dorsally or subdorsally near body margin; anal opening small, circular, without setæ, placed dorsally some distance before poste-

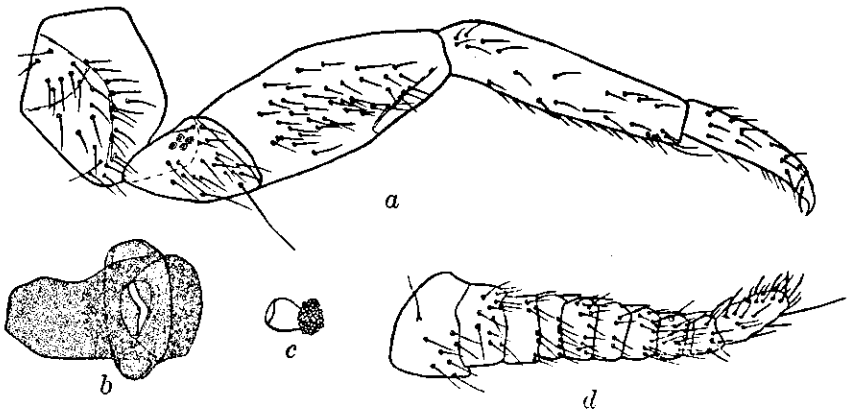

FIG. 5. *Lophococcus convexus* sp. nov., adult female; *a*, leg, × 57.5; *b*, thoracic spiracle, × 57.5; *c*, abdominal spiracle, × 57.5; *d*, antenna, × 57.5.

rior apex of body, joined by a short chitinized tube; genital opening placed ventrally near middle of abdomen and surrounded by a dense circular cluster of disk gland pores accompanied by some slender hairs; ventral cicatrices numerous, in groups of from one to five or more, arranged in six clusters curving forward from median posterior group on each side, making a total of thirteen groups; body dorsally and around the margin ventrally with a dense covering of stout, closely set, cylindrical hairs with bluntly rounded apices, among which are scattered disk gland pores with heavy walls, and occasionally a longer, slender, acute hair; ventrally with the area surrounding and posterior to the mouth parts bearing only numerous slender hairs and multilocular disk gland pores, a similar area present over venter of abdomen behind posterior legs, including cicatrices and genital opening, but with

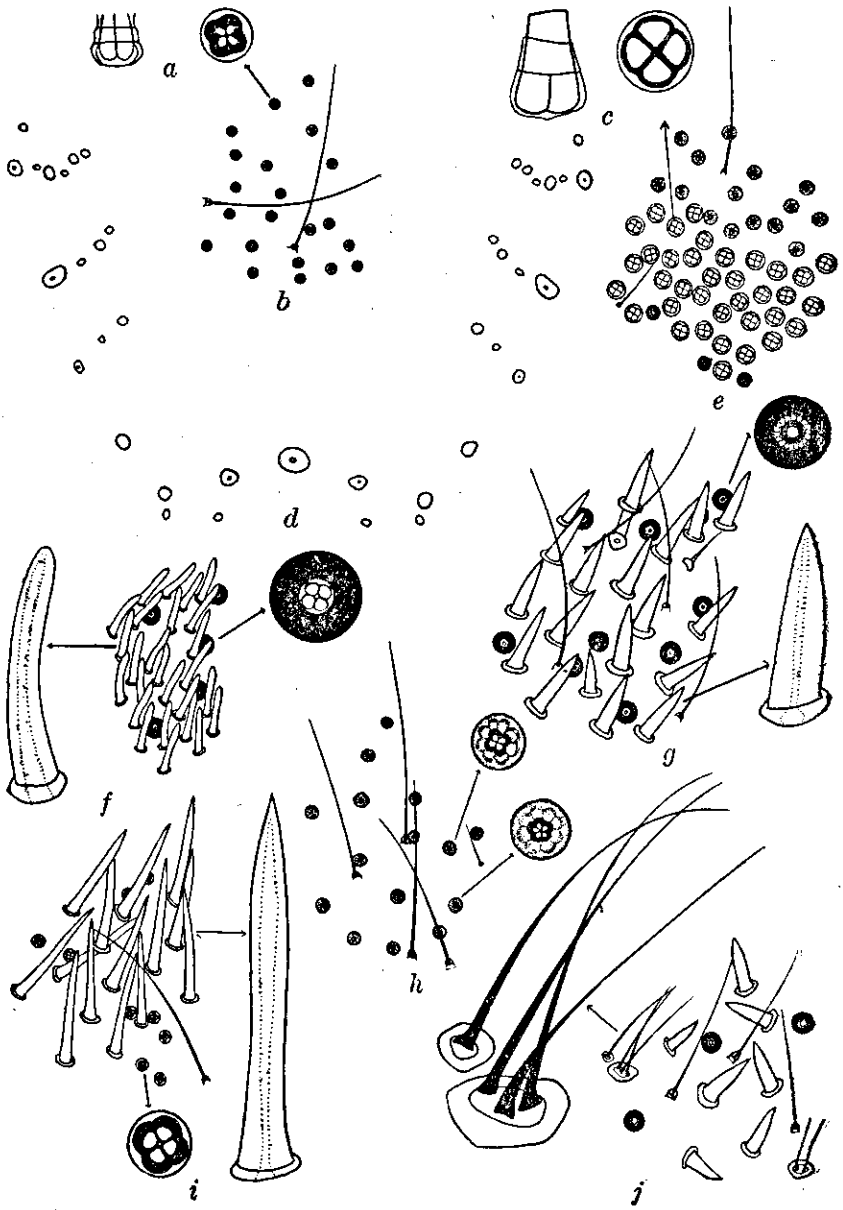

FIG. 6. *Lophococcus convexus* sp. nov., adult female, showing types of gland-pore and hair arrangements and ventral cicatrices; *a*, detail of quadrilocular pores placed ventrally posterior to beak, × 640; *b*, gross view of portion of same region, × 165; *c*, detail of glands from heavy band present ventrally in abdominal region, × 640; *d*, ventral cicatrices, showing large number and arrangement, × 30; *e*, portion of band mentioned under *c*, × 165; *f*, dorsal glands and spines, × 165, detail drawings, × 640; *g*, ventral submarginal spine, gland, and hair group, × 165, details of first two, × 640; *h*, glands and hairs occurring ventrally near genital opening, × 165, detail of gland, × 640; *i*, ventral spines, glands, and hairs near gland band mentioned under *c*, × 165, details of spine and gland, × 640; *j*, from same region as *g*, × 165, showing occasional development of more than one hair from a single base, with detail, × 640.

pores and hairs here arranged in fairly definite transverse rows instead of scattered as in the anterior area; this posterior area surrounded by a band of heavy gland pores, described later, and with large, stout, tapering, apparently hollow spines, which may sometimes be as much as 114 μ long, between these two areas and between them and the stout blunt spines of the dorsum and the margin of the venter, while interspersed among these sharp-pointed spines are long slender hairs, and occasional groups of two to four smaller slender hairs, all springing from a single heavily chitinized base; dorsal multilocular gland pores apparently of two types, some quadrilocular with the loculi circular, the others with an indeterminate number of smaller loculi arranged in a chain around a circular, oval, or somewhat triangular center, both of these types with very heavily chitinized borders; ventrally with about four somewhat different types of gland pores, around the mouth parts and behind them with small quadrilocular pores set in shallow cups, behind the posterior legs with a heavy circular band of quadrilocular pores set in deep cups and with large loculi, this circle surrounding the area in which the genital opening is placed; this area with transverse rows of disk pores with from three to six central loculi, the disk pores surrounding the genital opening placed in a large, closely crowded cluster, each with a single central nucleus and numerous indistinct loculi in a band around it; elsewhere on the ventral surface, particularly among the conical spines, with glands of the last type, but much more heavily chitinized and more distinct.

This species has been described from seven specimens mounted on slides and from a considerable number of unmounted specimens.

LUZON, Laguna Province, Mount Maquiling, on *Pithecolobium scutiferum*, July, 1918 (coll. *Baker*): Manila, on *Peltophorum ferrugineum*, 1911 (coll. *Compere 20186*). The types are in the United States National collection of Coccidæ.

While it is believed that the adult female has been characterized in the preceding description, there have been no larvæ or eggs found with any of the specimens. The Manila specimens are almost certainly immature, as none of them exceeds 9 millimeters in length. The presence of such a number and variety of ventral glands indicates the probability of the development of special secretions at the time of oviposition, and it may be found that when the female is fully mature she is even larger than the dimensions given in the description. Fully mature females, young larvæ, and males should certainly be looked for in the Philippines.

I have also seen specimens that are almost certainly this species from Java, where they were collected by Mr. P. van der Goot.

Genus **DROSICHA** Walker

The genus as recognized in this paper is sufficiently characterized in the key to genera to be recognizable. It is in all probability synonymous with *Monophlebus* Burm. as the latter genus is understood by E. E. Green and some other writers. One species has been collected in the Philippines.

Drosicha townsendi (Ckll.). Plate 1, fig. 3.

Monophlebulus townsendi COCKERELL, Proc. Dav. Acad. Sci. 10 (1905) 127 (♀); ROBINSON, Philip. Journ. Sci. § D 12 (1917) 4.

Drosicha lichenoides COCKERELL, Journ. Econ. Ent. 6 (1913) 142 (♀); ROBINSON, Philip. Journ. Sci. § D 12 (1917) 4.

Llaveia benguetensis COCKERELL, Journ. Econ. Ent. 9 (1916) 235 (♂); ROBINSON, Philip. Journ. Sci. § D 12 (1917) 5.

I have been especially fortunate in having available for examination the type material of both of the females listed above. A study of *M. townsendi,* the type material of which consists of a single specimen, shows clearly that at least one, and in all probability two, of the terminal segments of both antennæ are broken off, thus giving the impression that they are 6-segmented. A careful comparison with the type material of *D. lichenoides* shows that these two are the same. Neither of these females, as described by Cockerell, seems to be fully mature nor as large as the species becomes, in spite of the fact that Cockerell describes the eggs in his original description of the latter species. There does seem, however, to be a wide range in size of the adult female at the time of oviposition, and this may account for the fact that most of the adult females examined by me were larger than Cockerell's specimens. Through the collections of Mr. Geo. Compere in Manila it has been possible to examine a large quantity of material of this species, and to determine the synonymy of the male included above by a comparison of the males collected with the females by Compere, with Cockerell's description of *Llaveia benguetensis.*

In addition to the records given by Miss Robinson under the three different names, I have examined a large number of specimens as follows:

LUZON, Manila, on unnamed plant host, 1909 (coll. *Compere 15057*), on various plants, 1911 (coll. *Compere 21038*), on *Enterolobium saman* (coll. *Banks 9943*), on *Cassia* (coll. *H. S. Smith*), on *Hibiscus* (coll. *Arce 2567*): Laguna Province, Los

Baños, on *Eugenia malaccensis* (coll. *J. de Leon*, under *Banks 18456*), on unnamed host (coll. *Banks 18457*), on *Ipomoea carica* (coll. *Banks 18454*): Rizal Province, Pasig, on *Gymnosporia spinosa* (coll. *McGregor 376–4*).

On account of the previous confusion with regard to this species, some additional descriptive notes may assist in facilitating its recognition. The female becomes quite large, as much as 16 millimeters long, and strongly convex when mature and

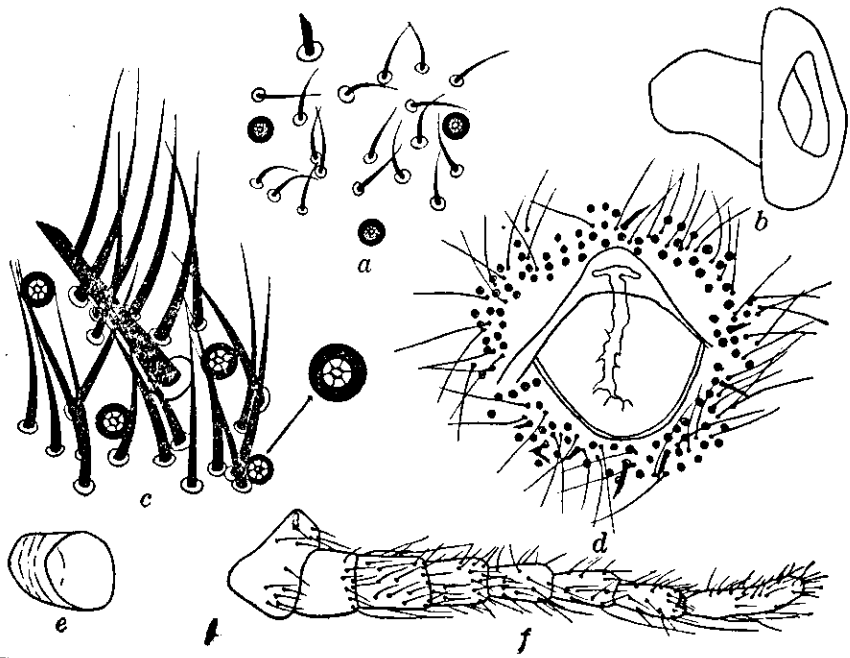

FIG. 7. *Drosicha townsendi* (Ckll.), adult female; *a*, hairs and glands from underside of body, × 335; *b*, thoracic spiracle, × 57.5; *c*, hairs and glands from dorsum near body margin, × 335, detail of gland, × 640; *d*, anal ring region, × 115; *e*, abdominal spiracle, × 335; *f*, antenna, × 57.5.

ready for oviposition. The anterior median notch seems to be constantly in evidence, although more conspicuous in the immature forms. At the time of oviposition, the female is much swollen, particularly behind the middle, and is concave as viewed from beneath, with the cavity well packed with cottony secretion. In the dried state, the female exhibits a considerable variety in size, shape, and coloring, and might easily be mistaken for more than a single species if isolated specimens had been collected. In spite of these apparent differences, the specimens examined seem to be identical structurally and there is sufficient variation in some of the large lots of material collected by Mr. Compere

from a single colony to include most of the differences in appearance shown by individually collected specimens.

The whole derm of this species is closely crowded with fine hairs, with larger ones of varying lengths, and a single type of multilocular disk gland pore but, with the number of loculi varying, scattered among the finer hairs, with the exception that dorsally in the anal ring region and ventrally in the region of the genital opening the glands are far more numerous and more closely crowded than elsewhere and the hairs are also more numerous. There are more or less distinct clusters of much larger and longer blackish hairs around the body margin and also some longer hairs ventrally between the antennæ and around the mouth parts. There are seven pairs of abdominal spiracles. In spite of the fact that Cockerell described *D. lichenoides* as having 9-segmented antennæ, none of the specimens examined, including part of the type material of that species, shows more than eight. There are three large ventral cicatrices or clear spaces, posterior to the genital opening, but these are collapsed and so faintly outlined in all the specimens examined that their exact size and shape are not determinable.

The young larva is oval with numerous body hairs and glands, and marginal groups, each composed of two or three, very long blackish hairs. The antennæ are 5-segmented, with the third and fifth segments much longer than the others and about equal in length, and the fifth distinctly clavate. The seven pairs of abdominal spiracles are present, although minute.

DACTYLOPIINÆ

This subfamily group is used here according to the classification in the Fernald Catalogue of the Coccidae of the World, although the collection of species placed here probably includes several subfamilies. The Philippine species of this group are united mostly by the characters given in the subfamily key. The legs and antennæ are present or wanting, or variously reduced; the body is naked, covered with secretion, or inclosed in a sac. The anal ring is located at the posterior apex of the body and bears setæ in all the known Philippine species.

Key to the Philippine genera of the Dactylopiinæ.

a^1. Body inclosed in a complete horny test or sac; body margin with a row of 8-shaped gland pores; legs wanting; antennæ very much reduced, minute..... Asterolecanium Targ.

a^2. Body naked or covered with cottony or mealy secretion; without 8-shaped gland pores; legs and antennæ usually present.

b^1. Without dorsal ostioles; without cerarii; anal lobes prominently developed, with dorsal spines and ventral setæ; body with a marginal fringe of large stout spines; naked; with a fringe of white thread-like filaments..... Rhizococcus Sign.

b^2. With at least a posterior pair of dorsal ostioles or oval openings near the caudal apex of the body; usually with cerarii or groups of spines and glands along the body margin, but without a continuous marginal fringe of spines; anal lobes not or very poorly developed; body covered with cottony or mealy white secretion, rarely naked.

c^1. Legs and antennæ well developed; body depressed, oval, covered with white mealy secretion and with more or less developed and protruding lateral and caudal filaments; posterior apex of body not invaginated.

d^1. Body with small chitinized areas laterally and dorsally, each bearing a pair of large, conical spines....Synacanthococcus g. nov.

d^2. Body without large, stout, grouped spines on dorsum, though sometimes with slender spines scattered over the upper surface.

e^1. Margins of each body segment bearing large, more heavily chitinized areas with a number of stout truncate spines and triangular gland pores on each; antennæ 9-segmented.... Puto Sign.

e^2. Margins of each body segment with not more than four or five spines in a single group, these all slender, pointed at apex, and not placed on a conspicuously chitinized area.

f^1. Antennæ normally 9-segmented..... ..... Phenacóccus Ckll.

f^2. Antennæ normally 8-segmented or less. Pseudococcus Westw.

c^2. Legs wanting; antennæ very rudimentary; body naked; globose, much wrinkled when dry, reddish brown; apex of body invaginated in the form of a small cylindrical tube with the anal ring at the inner end..... Antonina Sign.

Genus ASTEROLECANIUM Targioni Tozzetti

The members of this genus are all of small size, and have the female and immature stages completely inclosed in a horny and, usually, more or less transparent test or sac which bears a marginal fringe of filaments, usually brightly colored in life. The legs are wanting, the antennæ very minute, and there is a row, sometimes more than a single pore deep, of 8-shaped gland pores around the body margin, while additional pores of this type are frequently found on the dorsum. At present only one species from the Philippines has been examined, although, considering the large number which have been reported from the leaves of bamboo from Ceylon, it is difficult to believe that there are no more species in these Islands.

Asterolecanium bambusæ (Bdv.).

Chermes bambusae BOISDUVAL, Insectologie Agricole 3 (1869) 261.
Asterolecanium bambusæ (Bdv.) GREEN, Cocc. Ceylon 4 (1909) 328.

This species is listed from three lots of material collected at Manila on bamboo (*Compere 20230* and unnumbered) and (*Banks 10213*). It is one of the largest species in the genus, somewhat convex, broad oval in shape, and with a pinkish marginal fringe, at least in life. There is a single row of 8-shaped pores completely surrounding the body along the margin, and a few of the same type, but somewhat larger, dorsally near the middle line of the body.

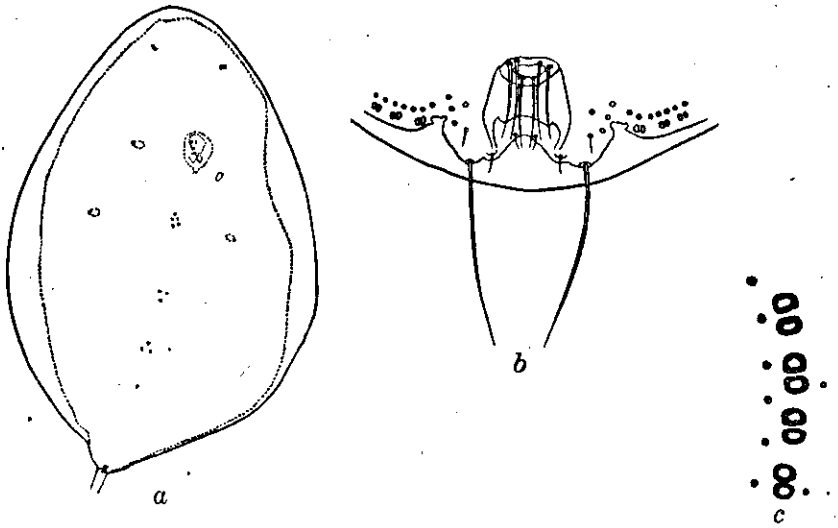

FIG. 8. *Asterolecanium bambusæ* (Bdv.), adult female; *a*, outline of body, showing marginal pores, dorsal pores, antennæ, spiracles, mouth parts, × 32; *b*, caudal apex of body, showing anal ring and lobes, × 325; *c*, detail of marginal double-pore band, × 640.

Genus RHIZOCOCCUS Signoret

It is possible to include here a single, new species of this genus, through the kindness of Professor Cockerell in sending specimens which had been sent to him for determination.

Rhizococcus philippinensis sp. nov. Plate 1, fig. 5.

Adult female.—Occurring on the small twigs of the host, particularly in the crevices formed at points where branches are given off; broad oval, the abdomen narrowed, about 1.5 millimeters long and nearly as wide, convex medially, the margins more or less flattened, strongly wrinkled or ridged transversely

on thorax and abdomen; reddish brown, mottled and spotted with lighter yellow; with a normally complete marginal fringe of short, white, cylindrical wax threads with tapering tips.

Body of female.—When mounted on a slide, oval; maximum length a little more than 1.5 millimeters, maximum width a little more than 1 millimeter; body and derm clearing completely when boiled in caustic potash; antennæ 6-segmented, III longer than the following segments combined, the measurements in microns as follows (measurements of I omitted):

II	III	IV	V	VI
36	82	21.5	18	36
32	82	17.5	16	32
36	82	(a)		
32	68	14	15	32
28.5	71.5	15	18	36
32	78.5	18	18	32

[a] Broken.

Legs normal for the group, the lengths of the parts of a hind leg as follows: Coxa (maximum), 100 μ; trochanter (maximum), 61 μ; femur (maximum), 121 μ; tibia (maximum), 89 μ; tarsus (maximum), 125 μ; claw, 25 μ; tarsal digitule, 43 μ; claw digitule, 30 μ. Claws with a small denticle before the apex; apices of both pairs of digitules knobbed, knobs of tarsal digitules much larger, almost circular; hind coxæ with about twenty-five to twenty-eight small pores on basal half of each, hind tibiæ with about six to eight similar pores above near apex of each; anal lobes well developed and chitinized, rather long, outer sides nearly straight, inner curved, inner faces more or less roughened and tuberculate, total length about 100 to 107 μ, apical hair at least 196 μ long, with three dorsal spines, the subapical near inner margin of lobe, stout at base, but with its apical half distinctly hairlike, inner and outer basal spines stouter, but with acute tips; with three hairs ventrally, the subapical one largest, the others close to the base, and the basal one smallest; with a large hair, about 115 μ long on each side between anal ring and anal lobe; anal ring surrounded by a chitinized band, united with the lobes and produced dorsally into a median chitinized cauda about 46 μ long and 57 μ wide, with a rounded and crenulate posterior margin; anal ring with six rather stout hairs, the longest noted about 107 μ long, the ring itself with a single row of large

pores, accompanied by from one to three smaller pores on the inner side of the middle seta, on each half; with a continuous row of rather closely set, large, tapering spines, varying somewhat in length, all around the margin of body, this row supplemented by an interior median pair between the eyespots, largest spines noted about 50 μ long; dorsally without tapering

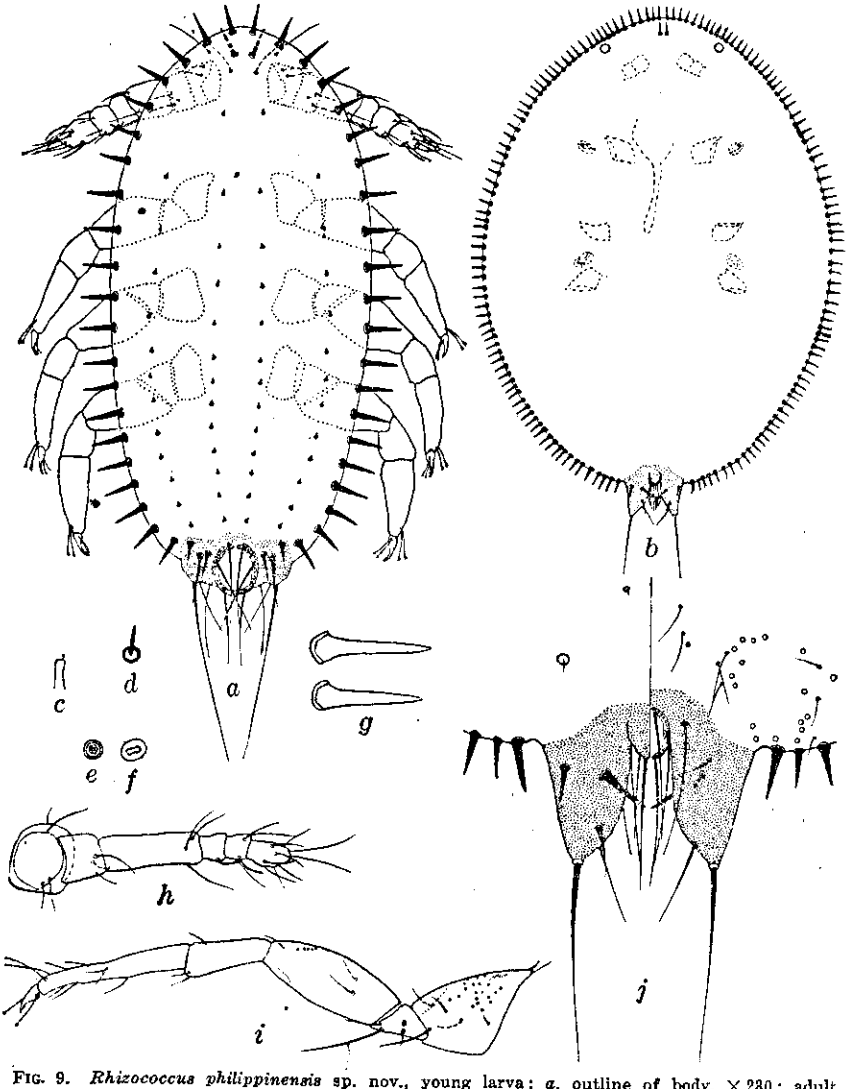

FIG. 9. *Rhizococcus philippinensis* sp. nov., young larva; *a*, outline of body, × 230; adult female; *b*, outline of body, showing spines and anal lobes, × 44; *c* and *d*, minute tubular ducts, × 640; *e* and *f*, body gland pores, × 640; *g*, marginal spines, × 335; *h*, antenna, × 165; *i*, hind leg, showing pores, × 165; *j*, anal lobe and ring region, × 165.

spines, with only a few minute cylindrical peglike spines set in circular bases, the spines about 7 μ long; ventrally, at least on abdomen, with transverse segmental rows of rather large hairs of varying length, the longest occurring near median line; dorsally, more particularly laterally, with fairly numerous minute tubular ducts, apparently with cup-shaped bottoms, although this has not been determined certainly; ventrally, particularly in the spiracular region and posteriorly, just before the anal ring, with fairly numerous, circular, multilocular disk gland pores, these all apparently quinquelocular.

Young larva.—Only embryonic larvæ inclosed in the body of the adult female have been available for examination, and consequently only a few structural details can be stated definitely. Antennæ 6-segmented, III only a little longer than any of the others; tarsal claw denticle only slightly developed, digitules about as in the adult; body with a marginal row of large spines and with four longitudinal rows of much smaller spines dorsally, at least on abdomen, these probably corresponding to the peglike spines of the adult; anal ring with six hairs, the cauda only slightly developed.

Intermediate stage.—A single specimen, apparently representing an intermediate stage of this species, shows only an intergradation of characters between the larva and adult, with one exception, this being the possession of a few large tubular ducts with cup-shaped bases, scattered dorsally, these apparently similar to those found in related genera and species, although it has not been possible to trace the usual slender continuation of the bottom, these occurring apparently in addition to the minute tubular type described in the adult.

This species has been described from four mounted specimens and a few more in position on the host, from Tibiao, Antique Province, Panay, on *Ficus* sp., May 9, 1918 (*McGregor*). The material was received through Professor Cockerell. The types are in the United States National collection of Coccidæ.

A rather hasty comparison of this species with specimens of other species in the collection at Washington indicates a fairly close relationship with *Rhizococcus intermedius* Mask., and, in morphological details, with *Eriococcus danthoniae* Mask. and *E. fagacicorticis* Mask.

The character of a majority of the descriptions of species in this genus is such that this species cannot be accurately compared with many of the species at present included here.

Genus PUTO Signoret [7]

The presence of the numerous groups of glands and spines, encompassed by more or less definitely chitinized areas, along the body margin of the species of this genus makes it readily recognizable. In addition, in the Philippine species the antennæ are 9-segmented and the tarsal claws have a denticle. Only a single species has been reported from the Islands.

Puto spinosus (Rob.).

Phenacoccus spinosus ROBINSON, Philip. Journ. Sci. § D 13 (1918) 145.

I have had no opportunity to examine type material of this species, but the abundance of material received from the Philippines makes it seem impossible that any other species could be involved. The species is evidently very closely related to *Phe-*

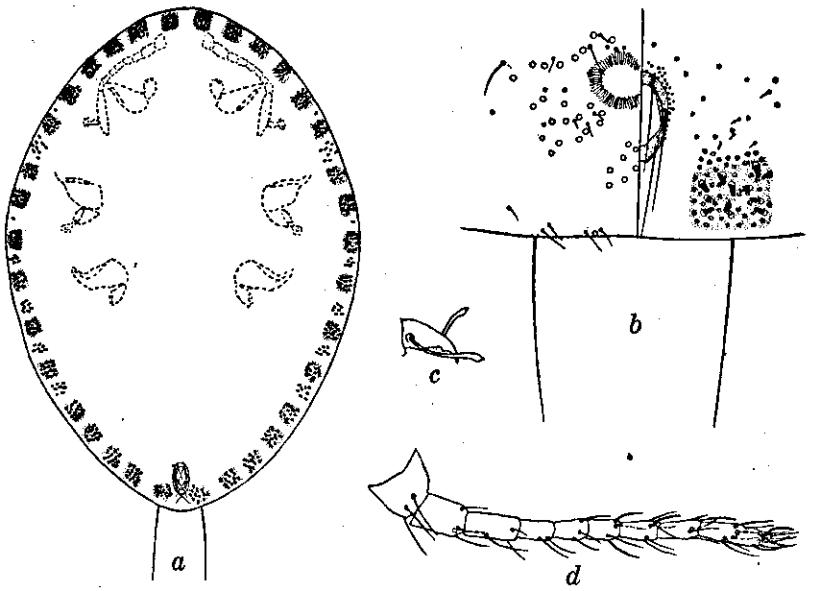

FIG. 10. *Puto spinosus* (Rob.), adult female; *a*, outline of body, showing principally the chitinized gland- and spine-bearing areas along the body margin, × 38; *b*, apex of abdomen, showing posterior chitinized area, anal and genital openings, and apical seta, × 110; *c*, claw, showing denticle, × 325; *d*, antenna, × 115.

[7] I have followed with no further study the conclusions reached by Ferris in regard to the synonymy of this genus and of *Ceroputo* Sulc, and have no opinion to express regarding this rearrangement. See G. F. Ferris, The California species of mealy bugs, Leland Stanford Junior University Publications, Univ. Ser. (1918) 61, 62.

nacoccus mangiferae Green, described from Ceylon, and Mr. Green, who has very kindly compared specimens with some of his material from Ceylon, states that it is identical with specimens which he has collected in Ceylon. In addition to the records given by Miss Robinson, I have examined specimens as follows:

LUZON, Manila, on "wild plants" (*Compere 20194*), "wild grass" (*Compere 20233*): Bulacan Province, Baliuag, on *Tabernaemontana* sp. (coll. *Arce 2619*); Katagpo, on *Antidesma leptocladum* (coll. *Arce 2609*); Quingua, on *Antidesma leptocladum* (coll. *Arce 2615*): Rizal Province, Balintauac, on *Mangifera indica* (coll. *Arce 2599*).

The accompanying figures and the characters given in the key should be sufficient to make this species recognizable.

Genus SYNACANTHOCOCCUS novum

Antennæ, legs, and mouth parts normally developed, the first 9-segmented in the adult female; claw of legs with a denticle beneath before apex; body with pairs of large, stout, triangular spines on both dorsum and margin; dorsally with triangular gland pores, large short-tubular ducts, and large, flat, circular disk pores; ventrally with the large disk pores last mentioned, with quinquelocular disk pores, and with minute tubular ducts, with threadlike continuation of the bottom of each; otherwise characteristic of pseudococcine forms.

Type of genus, *Synacanthococcus bispinosus* sp. nov.

Judging from a study of such descriptions, figures, and specimens of related species as are available, this new genus is possibly more closely related to *Tylococcus* Newst. than to any other described genus. The presence of the dorsal spines in all stages, of the female at least, would indicate a position in the eriococcine group of genera for this genus, according to the older ideas of classification, but it is obviously a pseudococcine form.

Synacanthococcus bispinosus sp. nov.

Adult female.—All of the material studied preserved in liquid at one time, and external secretion therefore wanting; occurring on small twigs of the host; the denuded forms, after preservation in liquid and subsequent drying out, clay yellow in color; maximum length, mounted on a slide, a little more than 2 millimeters; maximum width, nearly 1 millimeter; elongate oval, broadest a little behind the middle; not giving off any appreciable color or stain when boiled in caustic potash; antennæ normally 9-segmented, the joint between the last two segments only slightly

constricted, the measurements of the segments in microns as follows (segment I omitted):

II	III	IV	V	VI	VII	VIII	IX
46.5	28.5	23	28.5	24	28	28	46.5
40	32	25	32	25.5	32	25.5	46.5
46.5	28.5	(a)	------	------	------	------	------
50	32	(a)	------	------	------	------	------
50	32	26.5	35	26.5	32	25	50
47	35.5	26.5	35.5	35.5	32	28.5	52

[a] Broken.

Legs rather small, normal, the lengths of a middle leg as follows: Coxa, 64 μ; trochanter (maximum), 68 μ; femur (maximum), 161 μ; tibia (maximum), 164 μ; tarsus, 75 μ; claw, 25 μ; tarsal digitules, 39 μ; claw digitules, 21 μ. All digitules slender, slightly knobbed at apex, claw with a distinct denticle before the apex; only the posterior pair of dorsal ostioles noted; without marginal cerarii or groups of glands, pores, spines, and hairs on the body segments, these structures being replaced by pairs of stout conical spines, each set on a small, roughly circular, chitinized area, each of these chitinized areas also normally bearing a single triangular pore immediately inside and between the two spine bases, two minute clear circles on the same side and a single similar circle on the outer side; with sixteen or seventeen pairs of these along the body margin, all with two spines, except the second on each side from the anterior body apex, which usually has one; in addition with a row of nine similar spine clusters down the mid-dorsal body line, of which the anterior two have the individual spines separated by more than their own length and have an unchitinized space between them; with the last median pair on the sixth abdominal segment, and the next to the last on the third segment, these median pairs with the spines arranged transversely, and normally with two triangular gland pores, one on each side in the triangle between the spine bases; where the spines are separated, with one pore joined to each spine; with most of these pairs of large spines only slightly unequal in size, but with those on the anal lobes distinctly unequal, one about 21 μ long and 11 μ wide at base, the other about 25 μ long and only 7 μ wide at base, the spines in the median groups about equal; anal lobes not prominent, with an apical hair about 78 μ long, from which a ventral chitinized thickening, tapering anteriorly, extends forward; body with several types of gland tubes and pores: dorsally with some relatively very large, short-

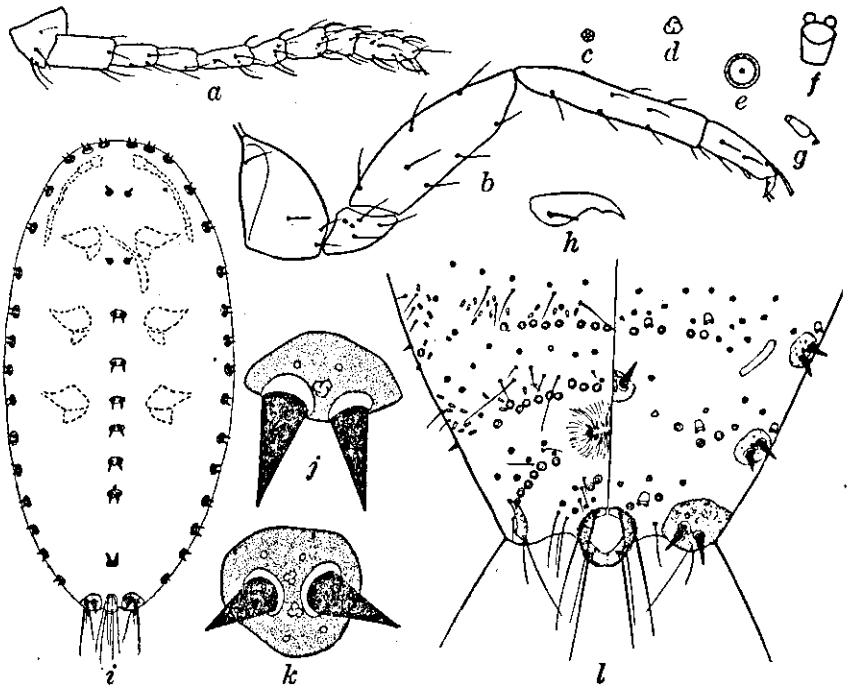

FIG. 11. *Synacanthococcus bispinosus* g. et sp. nov., adult female; *a*, antenna, × 165; *b*, leg, × 165; *c* to *g*, five different types of gland pores found on body, × 640; *h*, tarsal claw, × 640; *i*, outline of body, showing arrangement of spine groups, × 45; *j*, lateral abdominal spine group, × 640; *k*, median abdominal spine group, × 640; *l*, apex of abdomen, × 165.

tubular ducts with two or three minute circles attached to their outer margins, these two on the anal lobe segment, four with one pair marginal on the next segment anteriorly, six with one pair marginal on the next, and eight with one pair marginal on the remaining abdominal segments, these gland tubes also present, but in fewer numbers and uncertain arrangement, on head and thorax; next in size, with somewhat smaller, flat, circular disk glands with minute central pore and crenulations, possibly representing openings, near the outer margin, normally with four of these on the anal lobe segment, eight on the next anterior, and an increasing number on the anterior abdominal segments, and in the thoracic and head region, these usually more or less grouped in connection with the larger glands previously described; finally with a much larger number of the ordinary triangular and trilocular gland pores scattered over the whole dorsum and margin; ventrally with large disk glands already described for the dorsum but much more numerous, in transverse segmental rows, with tiny tubular glands

with a minute threadlike continuation of the bottom of each, also quite numerous, and with numerous quinquelocular disk pores, all of these obviously arranged in transverse rows according to the segmental divisions; thus with five different types of gland pores in this species; dorsally in addition to the large spines already described, with transverse segmental rows of minute conical spines; without spines ventrally, but with transverse segmental rows of relatively long slender hairs, these varying greatly in length among themselves; anal ring small, nearly circular, with six setæ, the longest about 90 μ long, and with two rows of pores on each half.

Young larva.—No satisfactory mounts of this stage obtained, but apparently with the paired spines of the adult present and in much the same arrangement, and with some, at least, of the same gland pore types present.

The species has been described from six adults and four larvæ mounted on slides, and from a small additional amount of material originally preserved in liquid but now dried out. The specimens are all from Manila, some from *Ficus* (*20158*), some from "wild plant" (*20176*), and some from wild fig (without number), all collected by Geo. Compere, exact date of collection not stated. The types are in the United States National collection of Coccidæ.

The presumed relationships of this genus and species have been indicated in the previous discussion of the genus. So far as my acquaintance with this group of coccids extends, it is rather unusual to find five different types of secreting gland pores in a single species.

Genus PHENACOCCUS Cockerell

This genus as limited here is characterized only by the occurrence of 9-segmented antennæ in the adult female. The cerarii of the single species included from the Philippines are poorly developed, in contrast to the usual condition in *Pseudococcus* and in the two preceding genera.

Phenacoccus hirsutus Green.

Phenacoccus hirsutus GREEN, Mem. Dept. Agr. Ind. 2[2] (1908) 25.

This species may be separated from the other known Philippine members of the group by the characters given in the generic key. Whether it will remain in the genus *Phenacoccus* when any generic revision of this subfamily is undertaken is very doubtful. There is no tooth on the tarsal claw, and there are only about six distinguishable pairs of cerarian spines on the

abdomen, on each side, the anterior pairs apparently becoming modified into large hairs or setæ, and the joint separating the eighth and ninth antennal segments is not so distinctly constricted as in other species of the genus. Each anal lobe bears a stout hair at least twice as long as the anal ring hairs. There appear to be four different types of glands present, large tubular, small tubular, large disk, and medium triangular, all of which are quite abundant, although not in the same numerical quan-

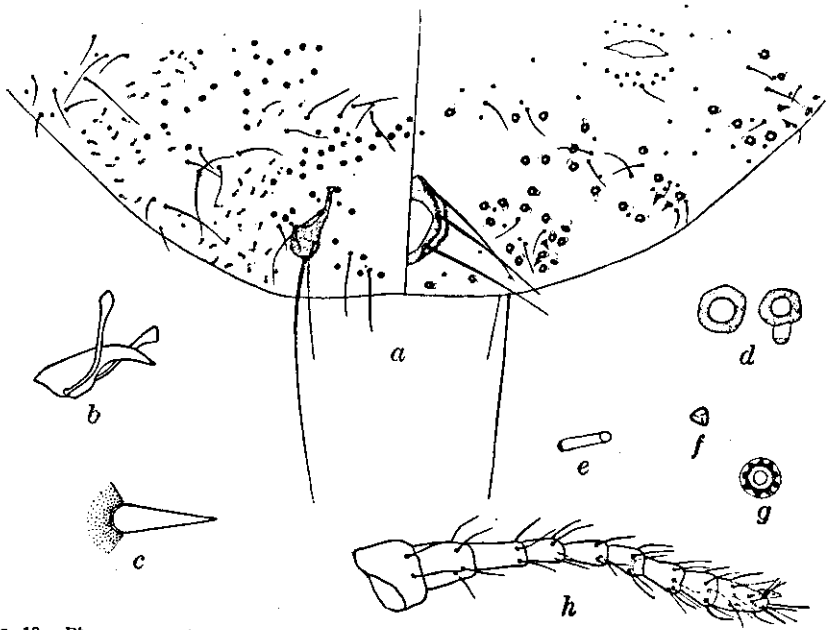

FIG. 12. *Phenacoccus hirsutus* Green, adult female; *a*, posterior apex of body, showing cerarii, glands, anal ring, apical setæ, and ventral chitinized area, × 115; *b*, tarsal claw, × 440; *c*, cerarian spine, × 640; *d* to *g*, four different types of gland pores found on body, × 640; *h*, antenna, × 115.

tity. The species as found in the Philippines occurs in abundance on the small twigs and leaves of its hosts, often in masses, and appears to form a matted sac, although the poor condition of all of the material studied prevents an accurate statement regarding the external appearance. I have examined specimens from the following lots of material:

LUZON, Manila, on *Hibiscus* (coll. *Compere 20172*): Bulacan Province, Baliuag, on *Samanea saman* (coll. *Arce 2608*): Rizal Province, Alabang, on *Hibiscus* (coll. *B. Duckworth 2566*).

Genus PSEUDOCOCCUS Westwood

This genus as used here includes some species which would need to be distributed to other genera in any revision of the

group, but is substantially as it is constituted in the Fernald Catalogue. It is characterized chiefly by having the antennæ normally 8-segmented or less, by the absence of a claw on the denticle, and by the usually well-developed cerarii. I have examined specimens of five species from the Philippines.

Key to the Philippine species of Pseudococcus.

a^1. Margin of body segments dorsally with a varying number of large, tubular glands, and with a dorsal median pair on most of the segments, each of these opening into a heavily chitinized plate bearing several hairs, these glands most numerous on the caudal abdominal segments and near the antennæ; with only an apical pair of cerarii; secretionary covering of female with glassy threads in it.
P. virgatus (Ckll.).

a^2. Without such prominent tubular glands, but often with smaller inconspicuous tubular glands present; cerarii more numerous in most species.

b^1. With the three or four abdominal segments anterior to the anal ring with a long slender seta on each margin, all of these approaching in length those found on the anal lobe segment; body large, plump, legs and antennæ short and stout; cerarii wanting except on the posterior abdominal segments. ..... P. sacchari (Ckll.).

b^2. With such large setæ only on the anal lobes.

c^1. With dorsal lanceolate spines; cerarii poorly developed, the spines lanceolate, and those anterior to the last four or five pairs widely separated and without grouped trilocular pores; antennæ normally 7-segmented, short and stout, as are the legs; female very plump, inclosed in a more or less distinct white secreted sac.
P. filamentosus (Ckll.).

c^2. Without dorsal spines, although sometimes with rather stout hairs; cerarii all well developed, the conical spines surrounded by a varying number of trilocular gland pores; antennæ normally 8-segmented; female not inclosed in a sac.

d^1. Ventral chitinized area on anal lobes irregularly quadrate; anal lobe hair only a little longer than anal ring hair; the penultimate or antepenultimate, and some of the anterior cerarii usually with three or even more spines in each cerarius.
P. bromeliae (Bouché).

d^2. Ventral chitinized area on anal lobes linear; anal lobe hair about twice as long as anal ring hair; abdominal segments with only two spines in each cerarius..... P. lilacinus Ckll.

Pseudococcus virgatus (Ckll.). Plate 1, fig. 7.

Pseudococcus virgatus (Cockerell), ROBINSON, Philip. Journ. Sci. § D 12 (1917) 6.

Pseudococcus virgatus (Cockerell), variety, Proc. Dav. Acad. Sci. 10 (1905) 130; ROBINSON, Philip. Journ. Sci. § D 12 (1917) 7.

A careful examination of the type material of *P. virgatus*, variety, fails to show any characters that would definitely distinguish the so-called variety from the species, and the suggestion

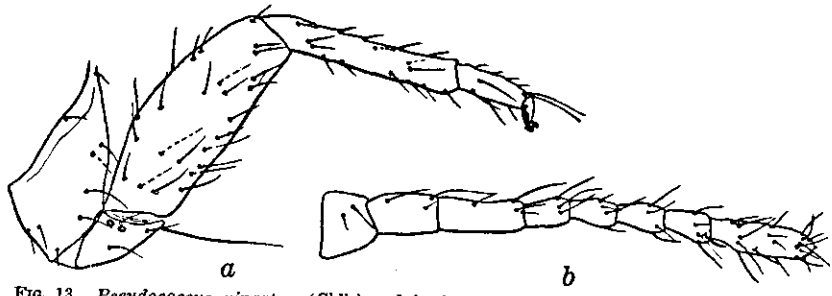

FIG. 13. *Pseudococcus virgatus* (Ckll.), adult female; *a*, leg, × 115; *b*, antenna, × 115.

of Brain [8] that the variety is not to be considered as distinct from typical *virgatus* seems to be entirely correct. The unreliability of the antennal formula and of the relative lengths of antennal segments as a specific characteristic has been proven so frequently that it hardly seems worth while to call attention to it again.

Specimens of this species from the following lots of material have been examined:

LUZON, Manila, on *Pithecolobium dulce, Achyrantes aspera, Amaranthus spinosus,* and *Acalypha wilkesiana* (coll. *Mc-*

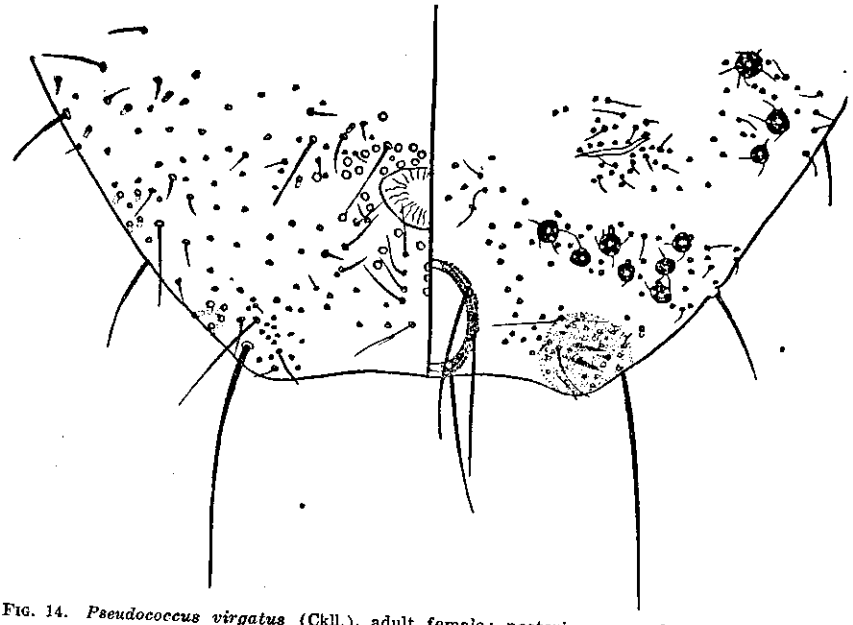

FIG. 14. *Pseudococcus virgatus* (Ckll.), adult female; posterior apex of abdomen, showing cerarius, peculiar heavy gland openings, anal ring, etc., × 97.

[8] Coccidae of South Africa, Trans. Royal Soc. South Africa 5 [3] (1915) 133.

Gregor), on cowpea (coll. *Arce 2588*), on *Lycopersicum esculentum* (coll. *Arce 2586, 2587*) : Bulacan Province, on guava (*McGregor*) : Laguna Province, Los Baños, on *Ricinus communis* (coll. *Banks 18461*), on *Mimosa pudica* (coll. *Banks 18460*), on *Xanthosoma sagittifolium* (Coccidæ Malayana, *9*, coll. *Baker*) ; Paete, on *Cyathula prostrata* (coll. *McGregor*) : Rizal Province, Fort William McKinley, on *Leucaena glauca* (coll. *McGregor*) ; Las Piñas, on *Wrightia laniti* (coll. *McGregor*) ; Pasay, on *Annona squamosa, Gliricidia sepium, Antigonon leptopus,* and *Jatropha curcas* (coll. *McGregor*) ; San Pedro Makati on *Pithecolobium dulce* and *Lantana camara* (coll. *McGregor*). Also from the Philippines on "Marang" [=~~*Artocarpus odoratissima*~~], collected at plant quarantine, Washington, D. C., by H. L. Sanford (F. H. B. *1320*).

Pseudococcus sacchari (Ckll.).

Dactylopius sacchari COCKERELL, Journ. Trin. Field Nat. Club 2 (1895) 195.
Pseudococcus sacchari (Ckll.), FERNALD, Cat. Cocc. World (1903) 109.

This species is represented by two lots of material, both collected at Manila by Geo. Compere, one on sugar cane (*20165*), the other on bamboo grass (*20229*).

Pseudococcus filamentosus (Ckll.). Plate 1, fig. 8.

Pseudococcus filamentosus (Ckll.), ROBINSON, Philip. Journ. Sci. § D 12 (1917) 8.

The following records, in addition to those given by Miss Robinson, may be listed for this species:

LUZON, Manila, on *Tamarindus indicus* (*2589*), *Annona reticulata* (*2570*) (coll. *Arce*) ; "wild bush" (*20170*), citrus (no number), and unnamed host (*20232*) (coll. *Compere*) : Bataan Province, Lamao, on orange (coll. *Wester*). The illustrations and key characters should make its separation from other Philippine species comparatively easy.

Pseudococcus bromeliae (Bouché).

Lecanium bromeliae BOUCHÉ, Schädl. Gart. Ins. (1833) 49.
Pseudococcus bromeliae (Bouché) FERNALD, Cat. Cocc. World (1903) 98.

What is unquestionably this species, as it is identified to-day, and as determined by a comparison with numerous specimens from pineapple from all over the world, was included in the material received for identification from Mr. Mackie. According to

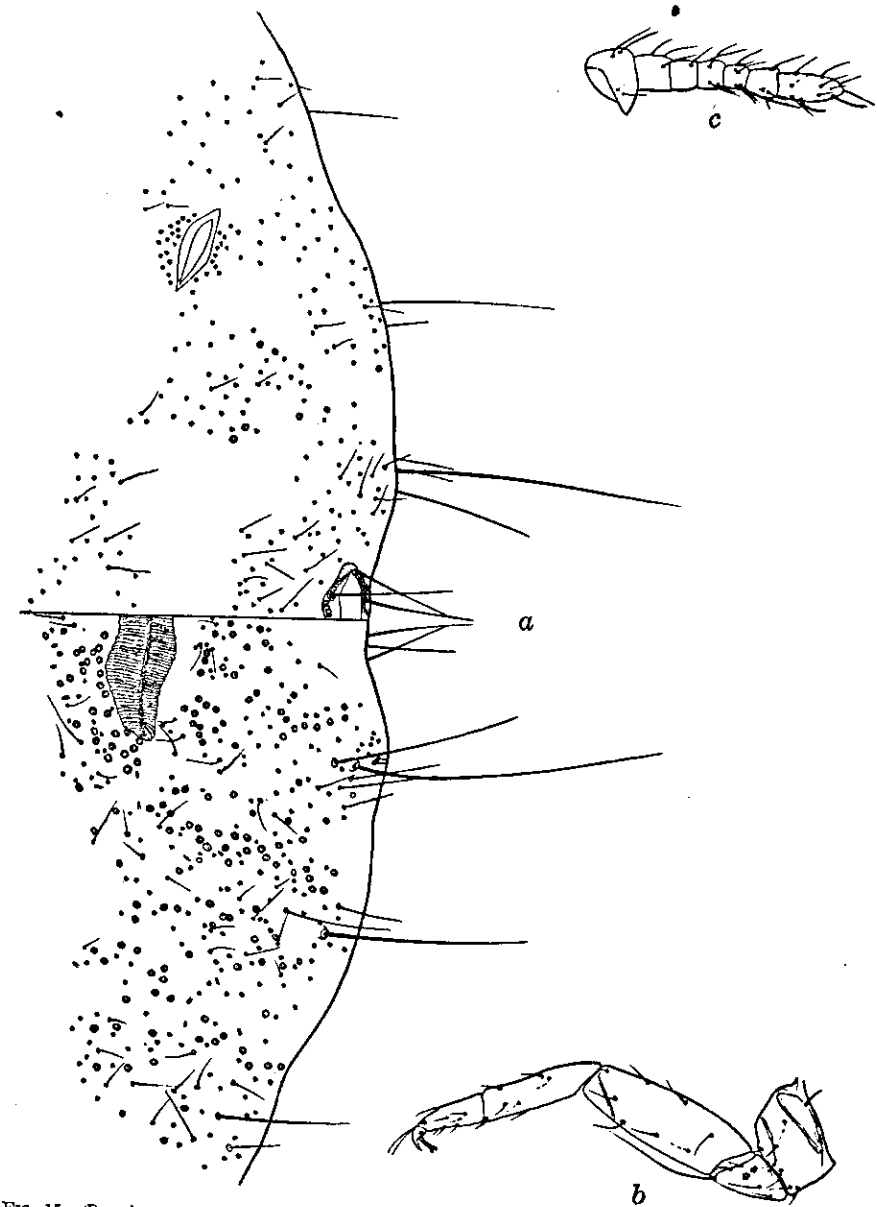

FIG. 15. *Pseudococcus sacchari* (Ckll.), adult female; *a*, posterior apex of abdomen, showing series of marginal hairs, etc., × 115; *b*, leg, × 115; *c*, antenna, × 115.

the records furnished by him, the material on which a record of the occurrence of this species in the Philippines is chiefly based was collected on *"Annona sativus"* at Manila (*Arce 2603*). I have consulted with Mr. W. E. Safford, of the Bureau of Plant

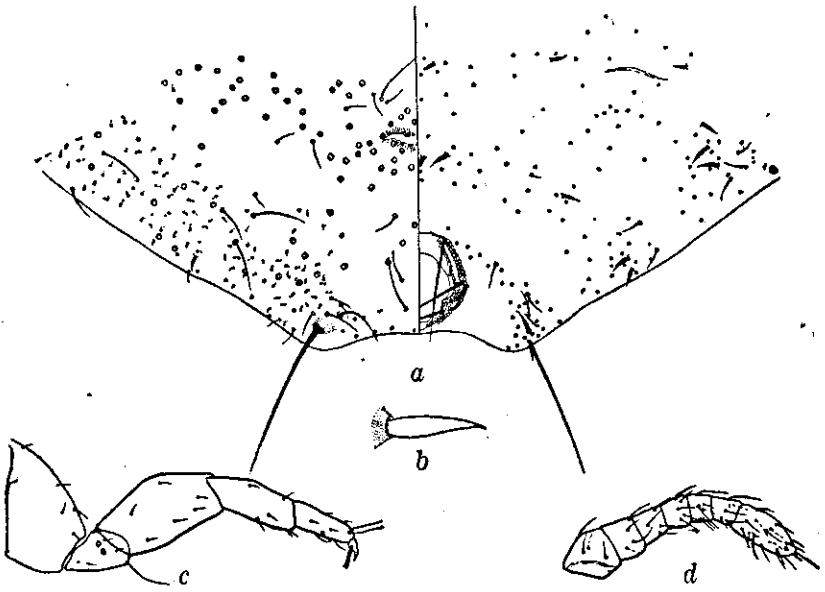

FIG. 16. *Pseudococcus filamentosus* (Ckll.), adult female; *a*, posterior apex of abdomen, showing cerarii, dorsal spines, anal setæ, anal ring, etc., × 115; *b*, dorsal spine, × 640; *c*, leg, × 115; *d*, antenna, × 115.

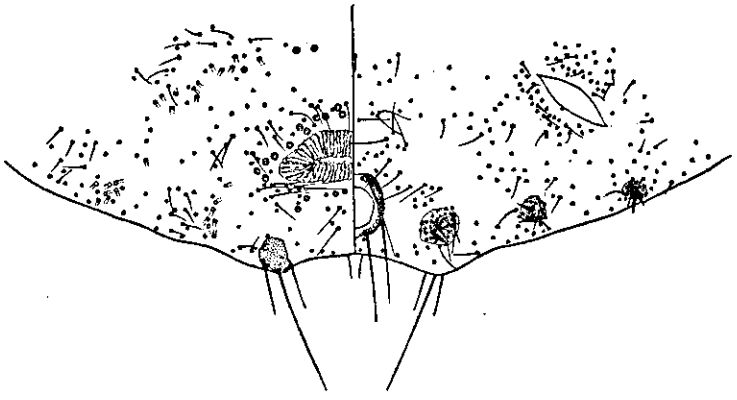

FIG. 17. *Pseudococcus bromeliae* (Bouché), adult female; end of abdomen, showing cerarii, apical setæ, ventral chitinized thickening, anal ring, etc., × 115.

Industry, United States Department of Agriculture, a specialist on the genus *Annona*, and he informs me that the specific name *sativus* has never been used in this genus. On the other hand, the name commonly given to the cultivated pineapple is *Ananas sativa*, and in view of the identity of the insect, it seems almost certain that the host record should be the latter name. The species has also been collected at quarantine, Washington, D. C., on banana received from the Philippines, by Mr. E. R. Sasscer.

Pseudococcus lilacinus Ckll.

Pseudococcus lilacinus COCKERELL, Proc. Dav. Acad. Sci. 10 (1905) 128; ROBINSON, Philip. Journ. Sci. § D 12 (1917) 7.

Pseudococcus tayabanus COCKERELL, Proc. Dav. Acad. Sci. 10 (1905) 129; ROBINSON, Philip. Journ. Sci. § D 12 (1917) 7.

Dactylopius crotonis GREEN, Tropical Agric. 24 (1905) 44 (without description); GREEN (as n. sp.), Journ. Econ. Biol. 6 (1911) 35, fig.

I am able to indicate the above synonymy through having type material of these three species available for examination, due to the kindness of the describers, Professor Cockerell and Mr. Green, in presenting material to the United States National collection of Coccidæ. The two lots of type material of Cockerell's species are very similar in general appearance before

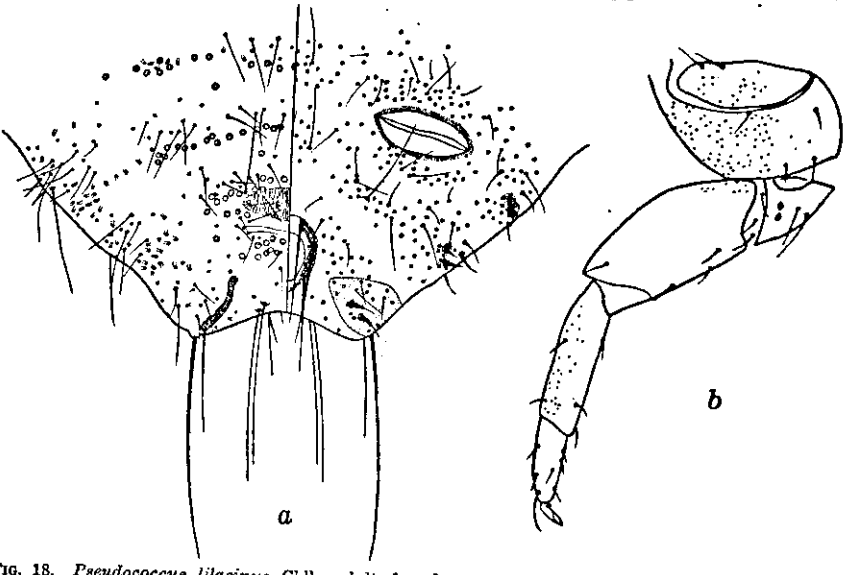

FIG. 18. *Pseudococcus lilacinus* Ckll., adult female; *a*, posterior apex of abdomen, showing cerarii, ventral chitinized thickening, anal ring, apical setæ, etc., × 115; *b*, hind leg, showing numerous minute pores on coxa and tibia, × 115.

mounting, and each is labeled "part of type"—of *lilacinus* and *tayabanus*, respectively. The two lots are of the same species so far as I have been able to determine from an extended study of mounted specimens. No attempt is made to account for the apparent discrepancy in regard to the color of the body after boiling in caustic potash, as given in the original description, although a possible explanation might be that the two species are really different, but that we had received two lots of the same species with different names attached. In the absence of any confirmation of this hypothesis it is only possible to place the second one described in the synonymy along with Green's *D. crotonis*.

Considering the wide distribution and wide range of host plants already recorded for this species, under its different names, it is my belief that it will ultimately be found to be some previously described species from another part of the world. It seems to be quite closely related to the common citrus mealy bug, *P. citri* (Risso), in many of its structural characters, but is viviparous, and has much stouter legs and antennæ.

Specimens from the following collections of Philippine material have been examined:

LUZON, Manila, on *Ficus cumingii* (*2605*), *Spondias purpurea* (*2595*), *Annona squamosa* (*2593*), *Annona glabra* (*2569*), and *Erythrina subumbrans* (*2604*) (all coll. *Arce*), bamboo (*Compere 20141*): Bulacan Province, Baliuag, on *Eugenia jambos* (coll. *Arce 2612*), on *Antidesma* sp. (coll. *Arce 2611*); Quingua, on *Premna odorata* (coll. *Arce 2610*), *Streblus asper* (coll. *Arce 2618*), *Semecarpus cuneiformis* (coll. *Arce 2613*): Laguna Province, Los Baños, on *Canangium odoratum* (coll. *Banks (18451)*; Paete, on *Ficus ulmifolia* (coll. *McGregor*): Rizal Province, Balintauac, on *Ceiba pentandra* (coll. *Arce 2601*), on coffee (coll. *Arce 2600*), on *Psidium guajava* (coll. *McGregor*); Culi Culi, on *Streblus asper* (coll. *McGregor*); Fort William McKinley, on *Psidium guajava* (coll. *McGregor*); Pasig, on *Streblus asper* (coll. *McGregor*).

Genus **ANTONINA** Signoret

This genus and its single Philippine species should be easily recognizable from the characters given in the key to genera.

Antonina zonata Green. Plate 1, fig. 6.

Antonina zonata GREEN, Ent. Month. Mag. 55 (1919) 175.

This is a plump, globular species found at the points where small bamboo stems branch, either beneath leaf sheaths or more or less exposed. In its dried condition it shrivels irregularly and is dark reddish brown in color, varying in size from 2 to 4 millimeters. The anal tube is surrounded by a somewhat circular, more heavily chitinized plate bearing numerous glands and hairs, and the anal ring setæ protrude half or more of their length beyond the mouth of the tube.

The species would appear to be at least fairly common from the records of material examined.

LUZON, Manila, on bamboo (coll. *Compere 20149*), on *Bambusa* sp. (coll. *Banks 10093*), on *Bambusa blumeana* (coll. *Arce 2598*): Bulacan Province, Baliuag (coll. *Banks 10151*).

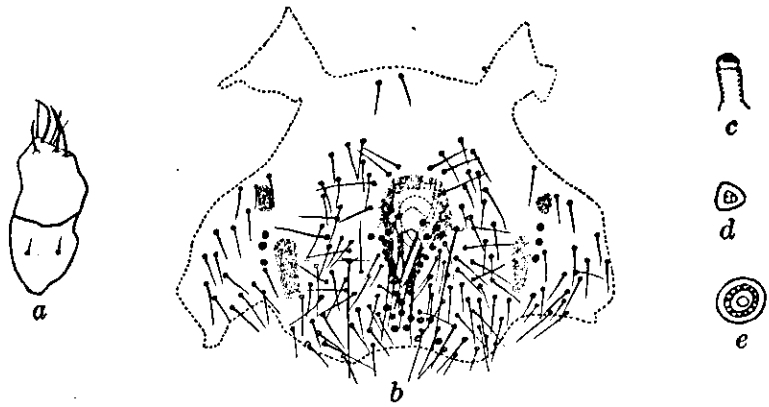

FIG. 19. *Antonina zonata* Green, adult female; *a*, antenna, × 335; *b*, anal plate and ring, × 115; *c* to *e*, different types of gland pores found on body, × 640.

TACHARDIINÆ

This subfamily includes only a single known genus, which is sufficiently characterized in the key to subfamilies.

Genus TACHARDIA R. Blanchard

This genus is now represented in the Philippines by two species, of which one has been previously reported from India, while the other is described as new in this paper. These species may be separated by the following key.

Key to the Philippine species of Tachardia.

a^1. Apex of spiracular processes or stigmatic plate large, circular or oval, with a broad chitinized area surrounding the central region containing numerous minute pores and about four to eight large tubular ducts, but no spines; posteriorly, near the anal lobe process, with several ball-like clusters of multilocular gland pores; plates surrounding the anal ring numerous, deeply and irregularly incised at apices; antennæ very short and stout ..... T. fici Green.

a^2. Apex of spiracular processes smaller, with a ridge surrounding a circular to oval area containing from two to six scattered pores and from nine to eleven conical spines, but no tubular ducts; without multilocular disk gland pores, except those near the spiracles; with sixteen clusters of peculiar gland ducts around the body margin; with only two plates and a few heavy spines around the anal ring; antennæ, while reduced, longer, fingerlike..... T. minuta sp. nov.

Tachardia fici Green.

Tachardia fici GREEN, Ind. Mus. Notes 5 (1903) 97.

This record is based on specimens collected at Manila from the aërial roots of a banyan tree (coll. *Compere 20157*).

This species appears to be very closely related to the common lac insect, *Tachardia lacca* Kerr.

Tachardia minuta sp. nov. Plate 1, fig. 4.

Adult female.—Occurring on the leaves of the host, mostly on the underside along the midrib; test somewhat egg-shaped, broadest behind, but with a constriction on each side about the middle, strongly convex, broadly ribbed laterally, this more pronounced on the anterior portion, posterior dorsal opening oval, located just at the end of the larval exuvium, the anterior pair of openings diagonally slitlike, placed just before the exuvium; maximum length, about 1.5 millimeters; color dark reddish to almost black.

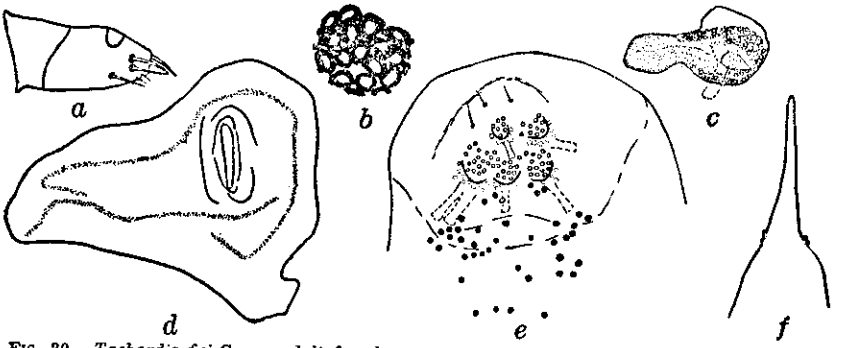

FIG. 20. *Tachardia fici* Green, adult female; *a*, antenna, × 335; *b*, group of gland pores from near anal lobe, × 640; *c* and *d*, spiracles, × 165; *e*, stigmatic plate, × 165; *f*, dorsal spine, × 165.

Body of female.—Shaped much as is the test; antennæ small, fingerlike, apparently 2-segmented, terminating in a chitinized plate bearing two long, stout, and two tiny, spines; total length, not including spines, about 53 μ, but variable; length of spines, about 12 μ; small spiracles strongly constricted medially, the larger nearly straight, several times larger than the smaller pair; spiracular processes apparently elongate, cylindrical, each terminating in a roughly circular chitinized plate bearing a large oval ring inclosing spines and pores, spines averaging nine to eleven in number, pores, two to six; the lobe bearing dorsal spine shorter than spine, stout, tapering somewhat, the spine about 80 to 90 μ long by 53 μ wide at base, basal third tapering strongly, the remainder very gradually, tip rounded, slender apical portion straight or slightly curved; anal lobe somewhat chitinized, the apical cap more than the rest, conical-rounded in shape with anal ring set in deeply at apex and surrounded by lobes and spines, the arrangement of the latter difficult to determine with certainty, but apparently posteriorly with two large lobes with a deep notch between them and with their apices more or less irregular or incised, laterally with two or three protuber-

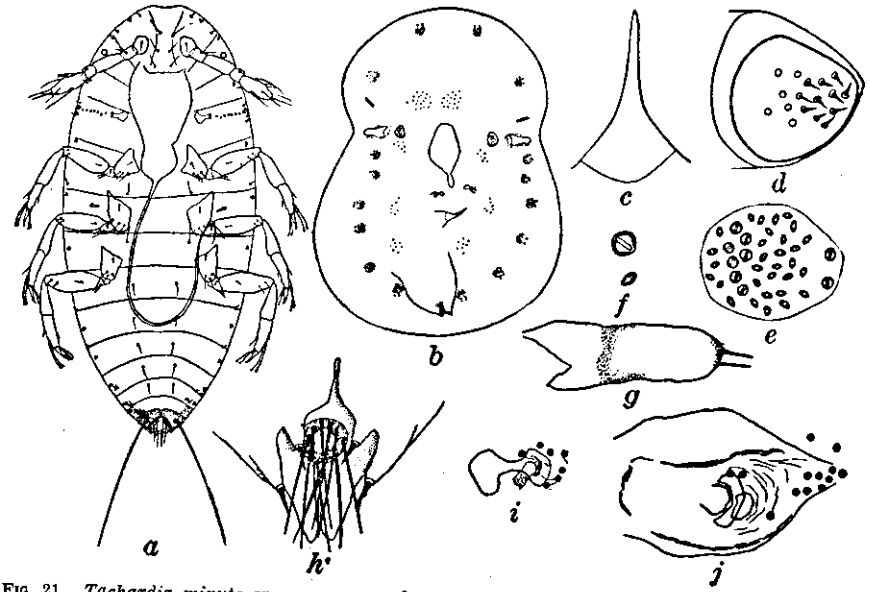

FIG. 21. *Tachardia minuta* sp. nov., young larva; *a*, from beneath, × 165; adult female, *b*, outline of body, showing position of various organs, × 38.5; *c*, dorsal spine, × 230; *d*, stigmatic plate, × 335; *e*, marginal group of gland pores, × 335; *f*, details of pores in same, × 640; *g*, antenna, × 335; *h*, apex of anal lobe, × 335; *i* and *j*, spiracles, × 335.

ances or tubercles on each side, each of these bearing a large stout spine, and anteriorly with the margin curving down more or less irregularly between the first spine on each side; anal ring with ten hairs, the longest about 50 μ, the division of each lateral half of the ring into upper and lower portions indistinct or incomplete; apparently with only a single type of gland over the body, but with a few circular, indistinctly quinquelocular gland pores near each spiracle; body gland pores peculiar in appearance, but so minute that it has not been possible to determine the structure definitely; apparently oval to circular, and either trilocular, with the loculi in a single row, or obscurely quadrilocular with one pair of loculi larger than the other, these in two sizes, the smaller occurring scattered in the body margin region, in about four small loose clusters, forming a row on each side, and outside of this row in sixteen compact clusters, surrounded by faint chitinization, running clear around the body, of which clusters the four anterior are the largest, the large pores occurring only in these last clusters, in which there are two on the outer edge of each cluster except the fifth and sixth from the caudal apex on each side, these having only one, and from two to eight in the inner half of each cluster, the latter surrounded by smaller pores.

Young (embryonic) larva.—Elongate oval, about 346 μ long by 150 μ wide, antennæ 6-segmented, the third and sixth longest, legs small, tarsal claw with denticle, all digitules long and slender; with a notch opposite the anterior spiracle, bordered in front by two and behind by one spear-shaped spine and with a single row of relatively large pores leading to spiracle; anal ring surrounded by a chitinized area, with six or eight setæ.

This species has been described from several females mounted on slides and some additional unmounted material, all collected on *Mangifera indica* at Isabela, Basilan, December, 1918 (*S. A. Reyes*), and forwarded by Professor Baker under No. *10102*. The types are in the United States National collection of Coccidæ.

This is the smallest species of this genus known to me. In its morphological characters it seems quite close to *Tachardia aurantiaca* Ckll., from which it differs in size, in having circular apices to the spiracular processes, with only a few spines and pores, instead of having a large triangular cap with a cluster of spines at one end and of pores at the other, and in other characters.

COCCINÆ

Members of this subfamily should be readily recognizable from the characters given in the subfamily key, since all the species have the pair of anal plates well developed, and all but *Ceroplastes* and *Vinsonia* show the anal cleft distinctly, while the heavy coating of solid wax covering the species of these genera is sufficient to distinguish them from any other Philippine coccids, with the possible exception of *Tachardia*. Species representing nine genera of the subfamily, as they are at present recognized, have been collected in the Philippines.

Key to the Philippine genera of the Coccinæ.

a^1. Marginal spines slender, linear, at most somewhat dilated and frayed at apices.

b^1. Body of female covered with and adherent to a thick coating of waxy or glassy secretion; spiracular spines usually numerous, stout, conical or bullet-shaped, clustered or spread out along the margin of the body.

c^1. Cephalic apex of body separated from remainder by a distinct suture; covering secretion of body extended into fingerlike prolongations, the whole giving the appearance of a 7-rayed star with hemispherical center. ..... Vinsonia Sign.

c^2. Without a separated cephalic lobe; waxy covering of body not protruding as in the preceding..... ..... Ceroplastes Gray.

b^1. Female not covered with wax or, if present, this very thin and easily separable from the body, transparent and glassy; spiracular spines usually with three or less in each group, rarely more.

d^1. Abdomen dorsally without compound "cribriform plates," three on each side of the anal opening; antennæ and legs present and at least fairly well developed.

e^1. With only a single, very long, spiracular spine opposite each spiracle; body inclosed in, but not attached to, a glassy test or sac..... **Ceroplastodes** Ckll.

e^2. With three or more spiracular spines in each group; body not inclosed in a glassy test.

f^1. Each anal plate very much longer than wide, these plates located near the center of the body; body more or less triangular with rounded angles; flat, with a small ovisac bordering the posterior margin of the body of the adult (cf. *Coccus* spp. if without ovisac) ..... **Protopulvinaria** Ckll.

f^2. Each anal plate more nearly triangular, the anterolateral margin usually only a little longer than the posterolateral, if much longer without ovisac in adult female; anal plates located nearer the posterior end of the body than the anterior; ovisac either wanting or very well developed; body slightly convex to hemispherical.

g^1. Adult female secreting a well-developed posterior ovisac and, sometimes, a cottony pad on which it rests. **Pulvinaria** Targ.

g^2. Adult female not secreting a posterior ovisac.

h^1. Body convex to strongly hemispherical; derm with large, heavily chitinized, polygonal or oval cells, each with a central pore..... **Saissetia** Despl.

h^2. Body only slightly convex; derm without the large, closely crowded, polygonal or oval areas, although sometimes with widely separated circular or oval areas ..... **Coccus** Linn.

d^2. Abdomen dorsally with six compound "cribriform plates," arranged in a semicircle, three on each side of and anterior to the anal plates; antennæ and legs rudimentary or absent. **Platylecanium** Ckll. and Rob.

a^2. Marginal spines much enlarged, flattened, broadly fan-shaped; body flat, broad-oval to nearly circular..... **Paralecanium** Ckll.

Genus PULVINARIA Targioni Tozzetti

This genus as at present recognized is characterized only by the full development of a posterior ovisac in the adult female. In the Philippine species the ovisac is well developed when completely formed, and the anal plates of all species have the posterolateral and anterolateral margins about equal in length, in contrast to *Protopulvinaria*, which has at times been included in

Pulvinaria. Four species and one variety have been reported from the Philippines, but I believe that the variety is invalid.

Key to the Philippine species of Pulvinaria.

a^1. Marginal spines large, stout, cylindrical or slightly tapering, and truncate at apices..... P. thespesiæ Green.

a^2. Marginal spines more slender, acute apically, or flattened and incised or fimbriated, never truncate, and much slenderer than spiracular spines.

b^1. Spiracular spines in each group four or five, one longer than the others, very rarely with only three in a group; marginal spines slender, the apices more or less fimbriated..... P. polygonata Ckll

b^2. Spiracular spines in each group normally three, one longer than the other two; marginal spines more or less distinctly flattened toward apices and incised at tips.

c^1. Marginal spines typically flattened at apices, but not or only very slightly broadened, strongly incised; mature female apparently without dorsal secretion..... P. tyleri Ckll.

c^2. Marginal spines typically distinctly broadened and incised apically, as well as flattened; mature female with more or less cottony or waxy secretion dorsally..... P. psidii Mask.

Pulvinaria thespesiæ Green.

Pulvinaria thespesiæ Green, ROBINSON, Philip. Journ. Sci. § D 12 (1917) 10.

The truncate marginal spines and the numerous spiracular spines of this species, as shown in the accompanying figure, make it readily recognizable among the other Philippine species. The following is the record of the material examined:

LUZON, Manila, on *Samanea saman* (coll. *Compere*), on *Zizyphus jujube* (coll. *Arce 2571*): Bulacan Province, Baliuag, on *Jatropha curcas* (coll. *Arce 2607*): Laguna Province, Los Baños (coll. *Banks 18465*): Rizal Province, Montalban, on *Homonoia riparia* (coll. *McGregor*).

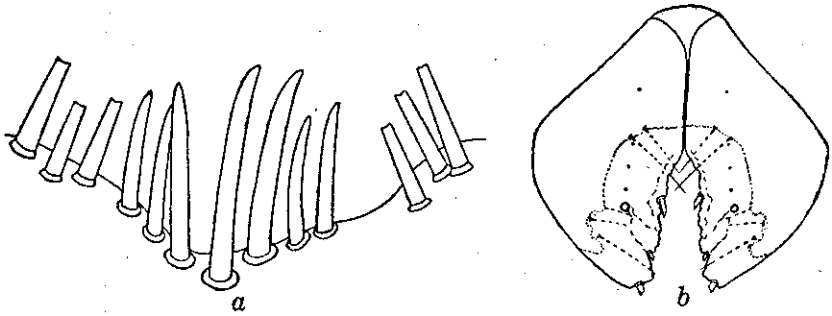

FIG. 22. *Pulvinaria thespesiæ* Green, adult female; *a*, spiracular and marginal spines, × 335; *b*, anal plates from above, × 165.

Pulvinaria polygonata Ckll. Plate 1, fig. 9.

Pulvinaria polygonata Ckll., ROBINSON, Philip. Journ. Sci. § D 12 (1917) 10.

Pulvinaria cellulosa GREEN, Cocc. Ceylon, pt. 4 (1909) 262.

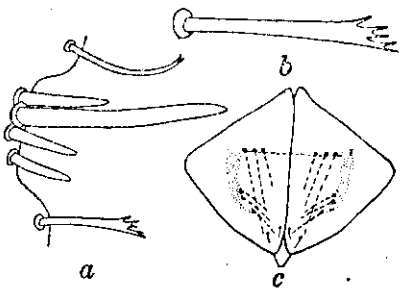

FIG. 23. *Pulvinaria polygonata* Ckll., adult female; *a*, spiracular and marginal spines, × 335; *b*, detail of marginal spine, × 640; *c*, anal plates from above, × 165.

Through the kindness of the describers of these two species in sending to the United States National collection of Coccidæ cotype material of each, it has been possible to make a direct comparison of specimens resulting in the synonymy indicated above. It is unfortunate that Green's species, which is excellently described and figured, should have to fall. In addition to the type material the following specimens have been examined:

LUZON, Manila, on orange (coll. *Compere*): Laguna Province, Los Baños, on *Citrus nobilis* (coll. *Baker 10096, 10097*).

Pulvinaria tyleri Ckll.

Pulvinaria tyleri Ckll., ROBINSON, Philip. Journ. Sci. § D 12 (1917) 9.

This species is somewhat doubtfully separated from the following, and it is possible that further study may show it to be some other already described species. In any event, this and the following are very closely related, but it is possible in the material at hand to separate two groups of specimens which show a somewhat different appearance of the marginal spines, those of

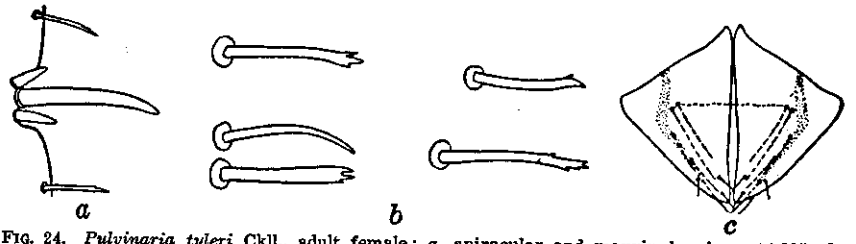

FIG. 24. *Pulvinaria tyleri* Ckll., adult female; *a*, spiracular and marginal spines, × 335; *b*, details of marginal spines, × 640; *c*, anal plates, × 165.

this species appearing longer and slenderer and only very slightly expanded at tips, in contrast to the typical condition in *Pulvinaria psidii*. There appears to be considerable normal variation in the spines of both species, and this appearance is increased through alterations from the normal position for the

spine, as when one is turned on edge, when viewed from above, or is foreshortened through curving up or down. Unfortunately all of the gross material examined is in very poor condition, so it is not possible to learn anything of the normal appearance of the adult female after the secretion of the ovisac, nor to obtain any very good mounted specimens. The lots of material included here are as follows:

LUZON, Manila, on various plants (coll. *Compere*), on *Antigonon leptopus* (coll. *Banks 14375*): Batangas Province, Batangas, on "Cadena de amor" (coll. *C. H. T. Townsend*) (type material): Rizal Province, San Pedro Makati, on *Lantana camara* (coll. *McGregor*). The type slide includes only three badly parasitized and mutilated specimens, and all of the material studied shows a decided degree of parasitism.

Pulvinaria psidii Mask.

Pulvinaria psidii Mask., ROBINSON, Philip. Journ. Sci. § D 12 (1917) 10.

Pulvinaria psidii philippina Ckll., ROBINSON, Philip. Journ. Sci. § D 12 (1917) 11.

A comparison of the type specimens of the subspecies listed above with the type specimens of Maskell's *Pulvinaria psidii* fails to disclose any characters by which I am able to differentiate the two. All of the specimens of the subspecies that have been examined unfortunatately have the antennæ broken off, but no other characters which would separate it from the typical material have been found, and in view of the well-known lack of constancy in the number of antennal segments in this and other groups of coccids, this material does not seem worthy of subspecific rank on the basis of this one character.

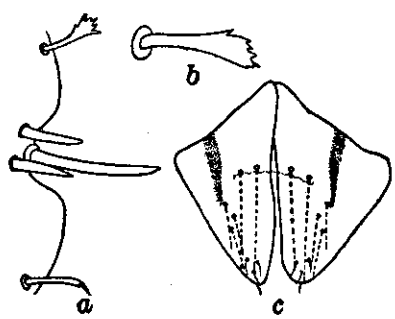

FIG. 25. *Pulvinaria psidii* Mask., adult female; *a*, spiracular and marginal spines, × 335; *b*, detail of marginal spine, × 640; *c*, anal plates from above, ×165.

The following records may be added to those previously published:

LUZON, Manila, on *Eugenia jambolana* (*10210*) and on unknown host (*10212*) (*Banks*), on unknown host (*Frank Dean*): Bulacan Province, on guava (*McGregor*): Laguna Province, Los Baños, on *Psidium guajava* (coll. *J. de Leon, Banks 13452*).

Genus **PROTOPULVINARIA** Cockerell

The single Philippine species of this genus might possibly be confused with two species of the genus *Coccus* in its immature stages prior to the formation of the fringe of white secretion around the posterior portion of the body, although in reality the tremendous length of the anal plates in relation to their width, together with the character of the marginal hairs, makes this species easily recognizable; but to prevent confusion, the species has been included in the key to the species of the genus *Coccus*.

Protopulvinaria longivalvata Green.

Protopulvinaria longivalvata bakeri COCKERELL and ROBINSON, Bull. Am. Mus. Nat. Hist. 33 (1914) 332, fig. 9; ROBINSON, Philip. Journ. Sci. § D 12 (1917) 9.

A careful comparison of type specimens of Green's species and Cockerell's subspecies has been possible on account of the receipt of such material from both of these men. While there is recognizable a tendency toward those differences indicated by

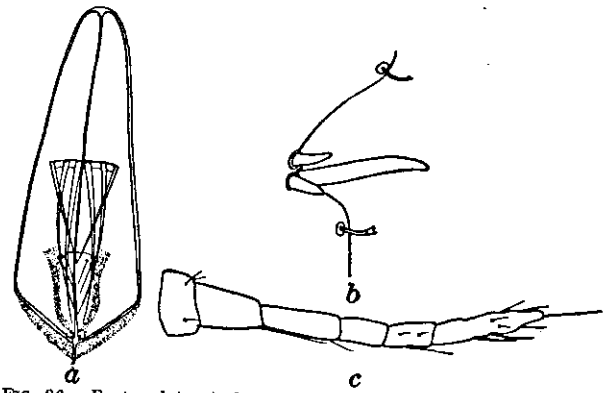

FIG. 26. *Protopulvinaria longivalvata* Green, adult female; *a*, anal plates, × 115; *b*, spiracular and marginal spines, × 640; *c*, antenna, × 165.

Cockerell when describing *bakeri*, I have been unable to conclude that the subspecies is based on anything that is not covered by individual variation. Both Green and Cockerell state that the antennæ are 8-segmented, yet a majority of the antennæ on the specimens available for examination are 7-segmented; with this much variation to begin with, any further consideration of the relative lengths of antennal segments seems quite futile. In addition to the type material of Cockerell's subspecies, material on *Piper betle* var., from Paete, Laguna Province, Luzon (*McGregor*) has been examined.

Genus VINSONIA Signoret

The single species included in this genus is represented by one lot of material from the Philippines.

Vinsonia stellifera (Westw.). Plate 1, fig. 10.

Coccus stellifera WESTWOOD, Proc. Ent. Soc. London (1871) 3, 111.

The external appearance and other characters of this species, as given in the key, are such that it can hardly be confused with any other coccid now known to occur in the Philippines.

The material examined was collected at Manila on mango (*Compere*). Green [9] gives an excellent account and figures of this species.

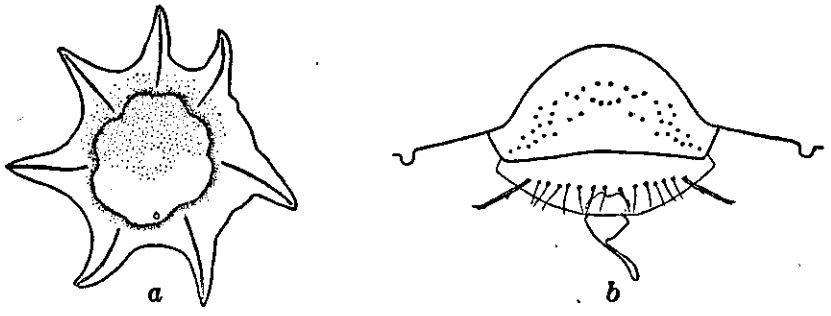

FIG. 27. *Vinsonia stellifera* (Westw.), adult female; *a*, outline of body, showing pointed secretionary projections, × 12; *b*, anterior portion of body, showing suture separating off the "head" and the antennæ, × 57.5.

Genus CEROPLASTES Gray

The thick waxy covering of the species of this genus makes their recognition an easy matter. Only a single species has been known from the Philippines heretofore, but through the collections received it is possible to add two others, while in all probability it will be possible to make still further additions when more specimens of certain collected lots of material are available for study.

Key to the Philippine species of Ceroplastes.

a^1. Size very large, length, about 17.5 millimeters; wax white, with a deep dorsal median pit..... C. gigas Ckll.[10]

a^2. Size smaller, usually not more than 12 millimeters; without a dorsal median pit.

[9] Coccidae of Ceylon pt. 4 (1909) 280.

[10] Included in the key from the original description only; no specimens examined.

b^1. Anal opening at the end of a long, nearly cylindrical, chitinized tube; spiracular spines numerous, mostly bullet-shaped; color of wax in life white or cream; size large, usually 10 to 12 millimeters. C. ceriferus (And.).

b^2. Anal opening on a short conical process; with one large conical and numerous globular spiracular spines; color in life rose red or grayish pink with conspicuous lateral white stripes; maximum length usually about 4 to 5 millimeters..... C. rubens Mask.

Ceroplastes ceriferus (And.).

Coccus ceriferus ANDERSON, Mon. Cocci ceriferi (1791).

If the characters given in the preceding key will not easily separate this species from the other known Philippine species, reference may be made to Green [11] where an excellent description

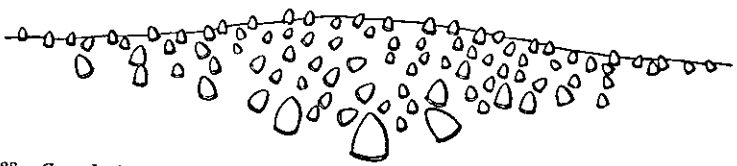

FIG. 28. *Ceroplastes ceriferus* (And.), adult female; group of spiracular spines, × 165.

and figures are given, both for this and the following species. I have examined material, all in bad condition, of this species from Los Baños, Laguna Province, on *Phytocrene* (coll. *Baker 2373*) and on *Ficus hauili* (coll. *Banks 18400*).

Ceroplastes rubens Mask.

Ceroplastes rubens MASKELL, Trans. N. Z. Inst. 25 (1892) 214.

I have examined specimens of this species from Manila on "palm, etc." (coll. *Compere 20180*), and on *Psidium guajava* (coll. *Banks 10624*). After death and some drying the specimens become dull yellowish brown and the wax becomes translucent.

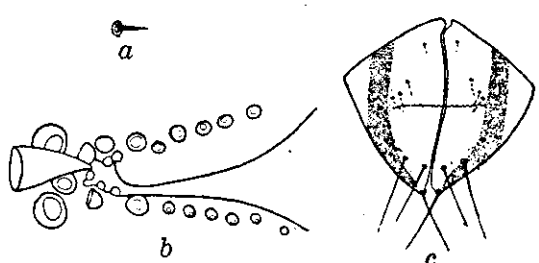

FIG. 29. *Ceroplastes rubens* Mask., adult female; *a*, marginal spine, × 640; *b*, spiracular spines, × 165; *c*, anal plates from above, × 165.

[11] Coccidae of Ceylon, pt. 4 (1909) 270.

Genus CEROPLASTODES Cockerell

The species of this genus are characterized by the presence of a glassy test which retains its stout oval shape while the adult female shrinks and shrivels into the anterior end as she deposits her eggs. This test is variously ornamented externally according to the species, and is usually extremely brittle, at least in dried specimens. Only a single species has been collected in the Philippines so far.

Ceroplastodes cajani (Mask.).

Eriochiton cajani MASKELL, Ind. Mus. Notes 2 (1891) 61.

Specimens which are apparently this species, although in very poor condition, are in Mr. Geo. Compere's collections from Manila, the first lot from guava (*1221*), the second on an unnamed host plant (*10243*). The generic characters already given should be sufficient to place this species, although here again reference may be had to Green [12] for an extended description and figures.

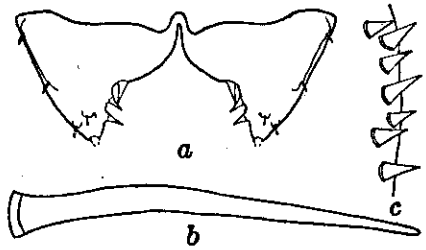

FIG. 30. *Ceroplastodes cajani* (Mask.), adult female; *a*, anal plates, × 165; *b*, spiracular spine, × 335; *c*, marginal spines, × 335.

Genus COCCUS Linnæus

This genus, as used here, agrees with the use in the Fernald Catalogue and consequently takes in a number of the species described by English entomologists under *Lecanium*. Four species, one of which is believed to be confined to the Philippines, have been collected in the Islands.

Key to the Philippine species of Coccus.

a[1]. Cephalolateral margin of anal plates distinctly much longer than caudolateral; body more or less distinctly triangular.

b[1]. Marginal spines distinctly shorter than smallest spiracular spines; anal plates extremely elongate; with a fringe of ovisac in adult female ..... Protopulvinaria longivalvata Green.

[12] Coccidae of Ceylon, pt. 4 (1909) 285.

b^2. Marginal spines distinctly longer than the smallest spiracular spines; anal plates less elongate; without traces of an ovisac at maturity.
c^1. With a heavy median band of very minute pores running cephalad from the anal plates, this with some lateral arms; with small circular pores more or less definitely arranged on the dorsum. Coccus diversipes Ckll.
c^2. Without such a band of minute pores; dorsally with fairly numerous medium-sized oval pores with rather definite arrangement. Coccus mangiferæ (Green).
a^2. Cephalolateral margin of anal plates at most very slightly longer than caudolateral margin; body more or less oval.
d^1. Marginal setæ small, short, prominently dilated and frayed at apices; antennæ normally 7-segmented.... Coccus viridis (Green).
d^2. Marginal setæ much longer, slender, entire or rarely very faintly frayed at apices; antennæ normally 8-segmented. Coccus elongatus (Sign.).

Coccus diversipes Ckll.

Coccus diversipes Ckll., ROBINSON, Philip. Journ. Sci. § D 12 (1917) 15.

This species does not appear to have been collected since the original lot of material from which it was described was obtained. Some figures are given in order to give a more elaborate idea of its characteristics than is to be obtained from the original description. As will be noted from these, it is quite closely related to the following species in many ways, but differs in the relation and character of the marginal and spiracular spines, as well as as in having the band of very numerous, minute dorsal pores.

Coccus mangiferæ (Green).

Lecanium mangiferæ GREEN, Ent. Month. Mag. (1889) 249; Cocc. Ceylon, pt. 3 (1904) 216.

This species is represented by a single lot of material collected at Paete, Laguna Province, on *Cocos nucifera* (coll. *McGregor*). The microscopic characters of the species as illustrated are quite distinctive.

Coccus viridis (Green).

Lecanium viride GREEN, Ent. Month. Mag. (1889) 284; Cocc. Ceylon, pt. 3 (1904) 216.
Coccus viridis (Green) ROBINSON, Philip. Journ. Sci. § D 12 (1917) 16.

While this is apparently a widespread tropical species, it has so far been collected only rarely in the Philippines. I have examined the following material:

LUZON, Manila, on *Citrus* sp. (coll. *Banks 10201*): Bataan

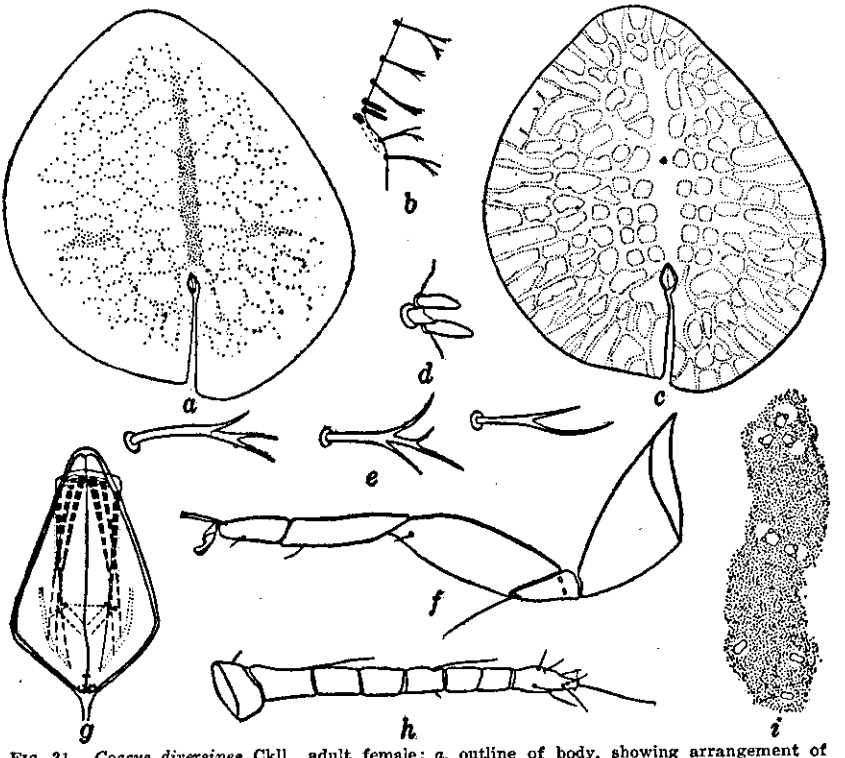

FIG. 31. *Coccus diversipes* Ckll., adult female; *a*, outline of body, showing arrangement of minute derm pores, × 17.5; *b*, spiracular and marginal spines, × 335; *c*, outline of body, showing faint areolation of dorsum, × 17.5; *d*, spiracular spines, × 640; *e*, marginal spines, × 640; *f*, leg, × 165; *g*, anal plates from above, × 165; *h*, antenna, × 165; *i*, detail of median pore band, × 640.

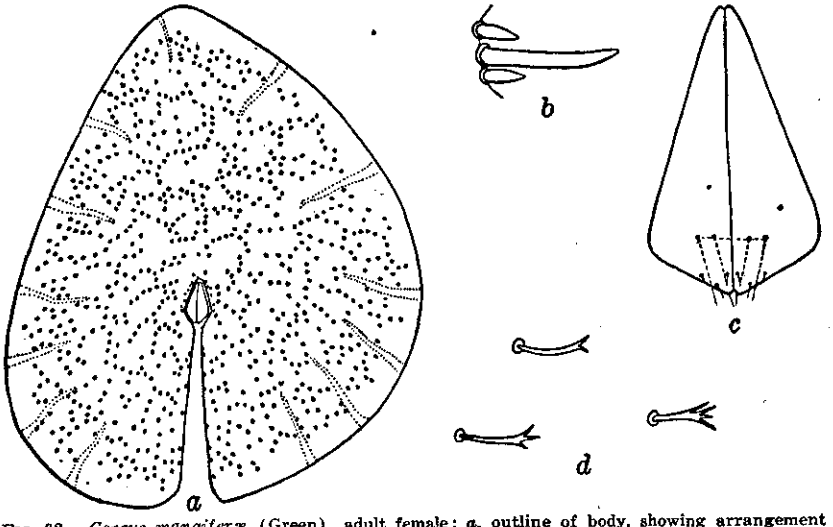

FIG. 32. *Coccus mangiferæ* (Green), adult female; *a*, outline of body, showing arrangement of derm pores, × 22.5; *b*, spiracular spines, × 640; *c*, anal plates from above, × 165; *d*, marginal spines, × 640.

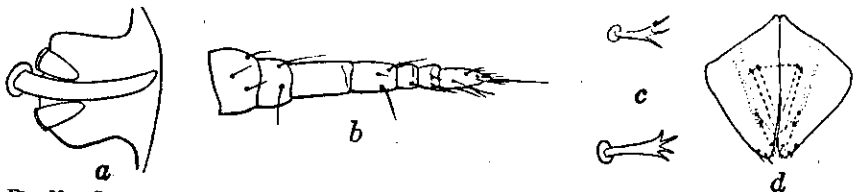

FIG. 33. *Coccus viridis* (Green), adult female; *a*, spiracular spines, × 640; *b*, antenna, × 165; *c*, marginal spines, × 640; *d*, anal plates from above, × 165.

Province, Lamao, on *Coffea* sp. (coll. *H. E. Stevens 18464*): Rizal Province, Pasay, on *Achras sapota* (coll. *McGregor*), in addition to that on which Miss Robinson's record is based. The species is bright green in life, in contrast to the following which is usually grayish or brownish.

Coccus elongatus (Sign.).

Coccus elongatus (Sign.), ROBINSON, Philip. Journ. Sci. § D 12 (1917) 15.

In addition to the records given by Miss Robinson, I have examined the following material:

LUZON: Manila, on mulberry (*20173*), on croton (*20155* and *20177*), and on orange (*Compere*), on *Gardenia florida* (*14581*) and *Codiaeum variegatum* (*10175*) (coll. *Banks*), on *Samanea saman* (coll. *McGregor*), on *Annona glabra* (coll. *Arce 2569*): Laguna Province, Los Baños, on *Annona muricata* (coll. *Banks 18458*).

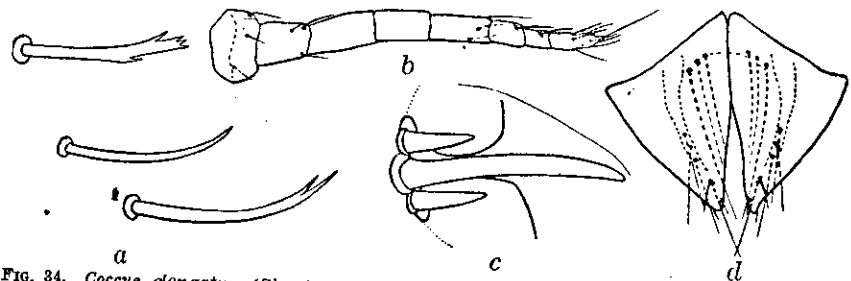

FIG. 34. *Coccus elongatus* (Sign.), adult female; *a*, marginal spines, × 640; *b*, antenna, × 165; *c*, spiracular spines, × 640; *d*, anal plates from above, × 165.

Genus **PLATYLECANIUM** Cockerell and Robinson

This genus is represented in the Philippines by the type species. In the original description of the genus, the authors state "ventral surface of abdominal region with groups of pores arranged in a semicircle," etc., this being one of the primary char-

acters of the genus. I have very carefully examined a portion of a specimen from the type material, all that has been available, and in addition specimens of *Platylecanium pseudexpansum* (Green), and of a third, undescribed species from Singapore, with the result that these pores appear to me to be quite certainly dorsal, instead of ventral, and the genus description should be changed accordingly. These groups of pores also occur in at least some species of the genus *Paralecanium.*

Platylecanium cribrigerum (Ckll. and Rob.).

Platylecanium cribrigerum (Ckll. and Rob.), ROBINSON, Philip. Journ. Sci. § D 12 (1917) 12, 13.

About a fifth of one specimen from the type material has been examined through the kindness of Professor Cockerell.

Genus PARALECANIUM Cockerell

This genus is composed of medium-sized, flat, oval to circular species, which have the marginal hairs modified into broadly expanded and flattened flabellæ which usually overlap more or less. I have been unable certainly to differentiate *Paralecanium expansum* Green and *P. cocophyllæ* Banks, and have therefore made use of the comparative characters given by Banks in his description in preparing the following key:

Key to the Philippine species of Paralecanium.

a^1. Legs and antennæ well developed, the latter 7-segmented. P. luzonicum Ckll.

a^2. Legs wanting; antennæ at most indistinctly 4- or 5-segmented.

b^1. Color pale yellow; marginal flabellæ broader in proportion to length and more narrowed at base; spiracular spines always three in each group; male puparium with seventeen plates. P. cocophyllae Banks.

b^2. Color reddish brown; marginal flabellæ more nearly circular or long oval, at most very slightly narrowed at base; spiracular spines varying from three to nine in each group; male puparium with eighteen plates..... P. expansum quadratum (Green).

Paralecanium luzonicum Ckll.

Paralecanium luzonicum Ckll., ROBINSON, Philip. Journ. Sci. § D 12 (1917) 12.

Through the kindness of Professor Cockerell, I have been able to examine a portion of the type material. This species does not appear to have been collected since the time it was described. It is easily separable from the other two known from the Phil-

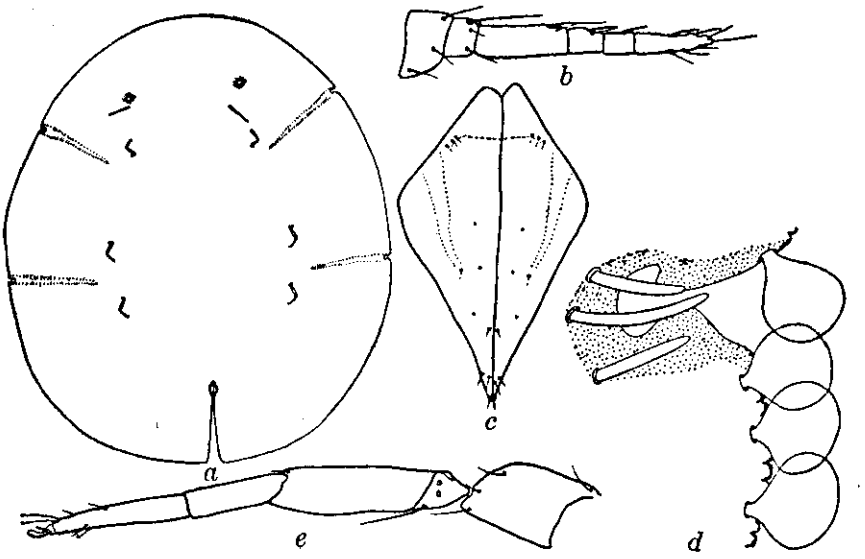

FIG. 35. *Paralecanium luzonicum* Ckll., adult female. *a*, outline of body, showing legs, antennæ, grooves opposite spiracles, etc., × 12; *b*, antenna, × 165; *c*, anal plates from above, × 165; *d*, spiracular and marginal spines, × 335; *e*, leg, × 165.

ippines, and also appears to be distinct from the numerous species with well-developed legs and antennæ described from Ceylon by Green in his Coccidae of Ceylon.

Paralecanium cocophyllæ Banks.

Paralecanium cocophyllæ Banks, ROBINSON, Philip. Journ. Sci. § D 12 (1917) 12.

Paralecanium expansum quadratum (Green). Plate 1, fig. 11.

Lecanium expansum var. *quadratum* GREEN, Cocc. Ceylon, pt. 3 (1904) 236.

Material from the Philippines which I have considered to be this species has been compared with specimens from Ceylon, sent by Mr. Green. While a number of variations from the normal characters found in typical *P. expansum* from Ceylon have been noted, I have been unable to conclude that the Philippine specimens are distinct from *expansum* var. *quadratum*, and place them under this name for the present without attempting to decide whether or not var. *quadratum* should be considered to be specifically distinct from true *expansum*. The Philippine material that has been examined appears to be intermediate between typical *expansum* and *cocophyllæ* as described by Banks.

In the collections listed below, the shape and the size of the body agree with *expansum;* the marginal flabellæ are more rounded and not quite so close together, so that the overlapping seems less pronounced; the spiracular spines occur normally in groups of three, but one clear example of five in a group was noted; the large derm pores are arranged approximately as in *ex-*

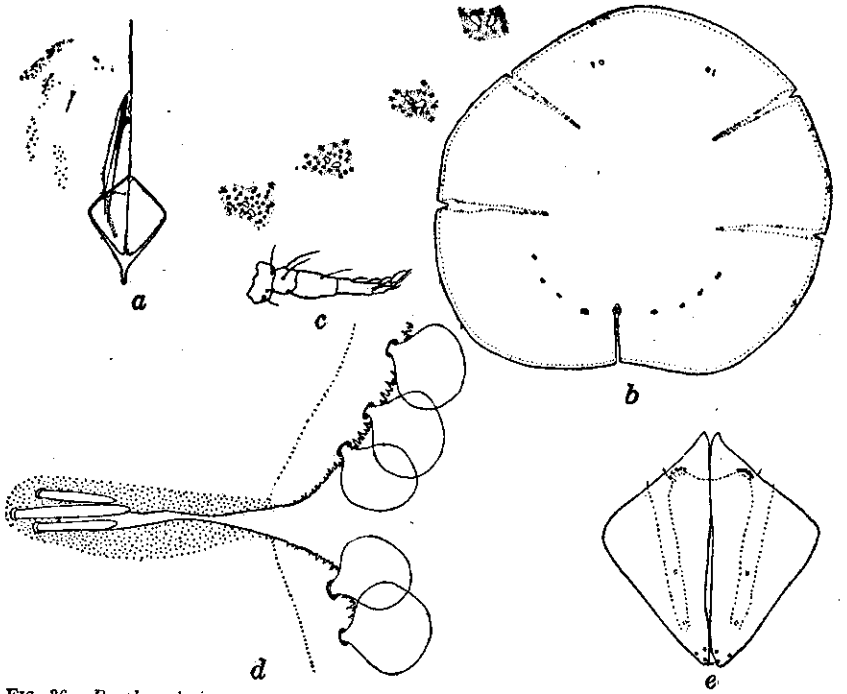

FIG. 36. *Paralecanium expansum quadratum* (Green), adult female; *a*, anal plate region, ventral and dorsal, showing pores and cribriform plates, × 57.5; *b*, outline of body, × 12; *c*, antenna, × 165; *d*, spiracular and marginal spines, × 335; *e*, anal plates from above, × 165.

pansum, but the grouped pores or "cribriform plates" running forward and outward from the anal plates occur in four groups on each side of the plates, instead of in three, thus resembling *cocophyllæ,* while the anal plates are stouter than in typical *expansum,* thus corresponding to var. *quadratum,* and also resembling *cocophyllæ* more closely. The color of the specimens examined is a dull yellow or light brown, thus suggesting a mean between that given by Green for *expansum* and that given by Banks for *cocophyllæ,* although small differences may be accounted for in a number of ways. The following material has been examined:

LUZON, Manila, on bark of ylang ylang tree (coll. *Compere 20146*): Laguna Province, Paete, on *Diplodiscus paniculatus* (coll. *McGregor*).

Genus **SAISSETIA** Desplanches

Three very common and widespread species, members of this genus, have been reported from the Philippine Islands, and another, apparently new, is described herewith. The usually convex to hemispherical shape, and the development of a heavily chitinized and areolated dorsal derm, are the characteristics at present accepted to isolate this genus.

Key to the Philippine species of Saissetia.

a^1. With only about ten to twelve submarginal gland tubercles around the body margin; marginal setæ more or less flattened and broadened at apices; species larger, oval or hemispherical, with or without ridges.
  b^1. Female without ridges of any sort in the adult stage, either strongly hemispherical or much less convex and oval.
    c^1. Female strongly convex, hemispherical; color usually yellow brown; derm areas oval and often separated by more than their own diameter ..... S. hemisphaerica (Targ.).
    c^2. Female at most only moderately convex; nearly black; derm areas large, closely approximated, polygonal..... S. nigra (Nietn.).
  b^2. Female strongly convex; very dark brown or blackish brown; dorsum with distinct ridges in adult, these forming a transverse H-shaped mark..... S. oleae (Bern.).
a^2. With more than forty submarginal gland tubercles around the body margin; marginal setæ tapering, acute at apices; species small, irregularly triangular, not very convex, with three dorsal ridges radiating from the center to the corners of the body..... S. triangularum sp. nov.

Saissetia hemisphaerica (Targ.).

Saissetia hemisphærica (Targ.), ROBINSON, Philip. Journ. Sci. § D 12 (1917) 14.

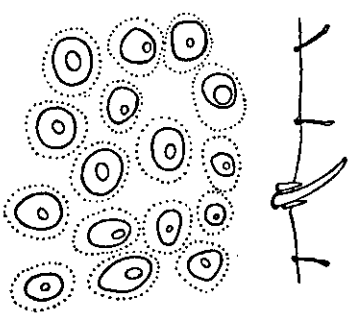

FIG. 37. *Saissetia hemisphaerica* (Targ.), adult female, showing derm areolation, marginal and spiracular spines, × 165.

To the records given by Miss Robinson, the following may be added:

LUZON, Manila, on *Chrysophyllum cainito* (*10074*), on unknown host (*10218*), on *Thunbergia grandiflora* (*16666*), on *Cycas revoluta* (*18463*) all collected by *Banks*, on ornamental vine (coll. *Baker 10100*): Rizal Province, Pasay, on *Coffea arabica* and *Tabernaemontana pandacaqui* (coll. *McGregor*).

Saissetia nigra (Nietn.).

Saissetia nigra (Nietn.), ROBINSON, Philip. Journ. Sci. § D 12 (1917) 14.

Specimens of this species have been examined from the following localities:

LUZON, Manila, on *Canna indica* (*10169*), on *Manihot utilissima* (*10174*), on *Erythrina indica* (*10209*), all collected by *Banks:* Batangas Province, Nasugbu, on *Morus alba* (coll. *Banks 10198*).

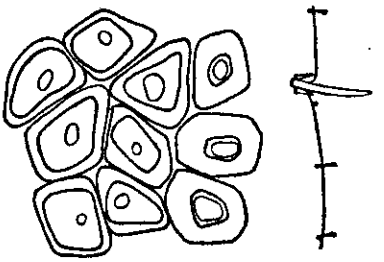

FIG. 38. *Saissetia nigra* (Nietn.), adult female, showing derm areolation, marginal and spiracular spines, × 165.

Saissetia oleae (Bern.).

Saissetia oleæ (Bern.), ROBINSON, Philip. Journ. Sci. § D 12 (1917) 13.

I have seen no specimens of this species from the Philippines, and the accompanying drawing has been made from specimens from the United States.

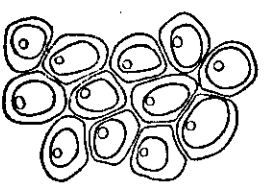

FIG. 39. *Saissetia oleae* (Bern.), adult female, derm areolation, × 165.

Saissetia triangularum sp. nov.

Adult female.—Occurring on the undersides of the leaves of the host; about 1.5 millimeters long by 2 millimeters or less wide, typically very broad-triangular, with both sides and angles rounded, widest far behind the middle, but the shape quite variable and sometimes asymmetrical; slightly convex, but with three broad and usually prominent ridges meeting at about the center of the body and radiating to the anterior and the two posterior lateral corners of the body; anterior corner more or less indented; spiracular spine regions very indistinctly indented; a light reddish brown in color in the dried state.

Body of female.—Gradually clearing when boiled in caustic potash, the marginal areas first, finally becoming almost wholly transparent, the derm areolations not extending to the body margin, of the same type as those found in *S. nigra,* but much smaller, more delicate and even more irregular in size and shape than in that species; antennæ 6-segmented, the third much the longest, about as long as the following three combined, the measurements in microns as follows:

I	II	III	IV	V	VI
25	25	89	21.4	25	53.5
25	26	85.7	39		50
25	32	93	21.4	19	43
23	25	82	21.4	18	39
25	28.5	91	25	21.4	43.5
26.5	35.7	93	26.5	25	50
25	32	96	22	23	50
25	32	96	24	21.4	46.5
21.4	28.5	85.7	21.4	24	46.5

Legs not unusual for the genus, tibia and tarsus approximately equal in length; spiracles slender and somewhat cylindrical in middle, broadly expanded at each end; marginal setæ numerous, long, slender, bluntly pointed at apices, spaced irregularly, but averaging about their own length apart, averaging about 32 μ in length, posterior spines longer, those on each side of the apex of anal cleft as much as 100 μ long; spiracular spines in groups of three, the middle a little more than twice the length of either of the other two, the latter often slightly unequal in length, all stout, the smaller tapering uniformly to a rounded apex, the larger tapering distinctly only near the apex; dorsally with some widely scattered tiny peglike tapering spines, apparently arranged in curving longitudinal rows; ventrally with a submarginal row of tiny setæ and with a few others, similar, scattered over the under surface of the body, with three pairs of long, slender setæ just anterior to the anal lobes and another pair, unequal in length, inside each antennal base; dorsally with an abundant supply of minute, short-tubular gland ducts, each with a slender, threadlike continuation of the bottom, with a cluster of circular disks, presumably glandular, anterior to the anal plates, and with a median cluster of bilocular and circular pores nearly opposite or a little behind the middle legs; ventrally with a single to triple line of circular quinquelocular pores between the spiracles and the corresponding spine groups, and with larger multilocular pores, with nine or ten loculi and large open centers, in a cluster around the anal plates; submarginal gland tubercles very numerous, varying from forty-two to forty-eight in the specimens examined, often with an uneven number on each body half, and sometimes with two, one within the other, at the same point on the margin; anal plates in normal position, the cleft short, triangular, nearly twice as long as wide, the posterolateral face distinctly longer than the anterolateral, under compression appearing proportionately broader, with the

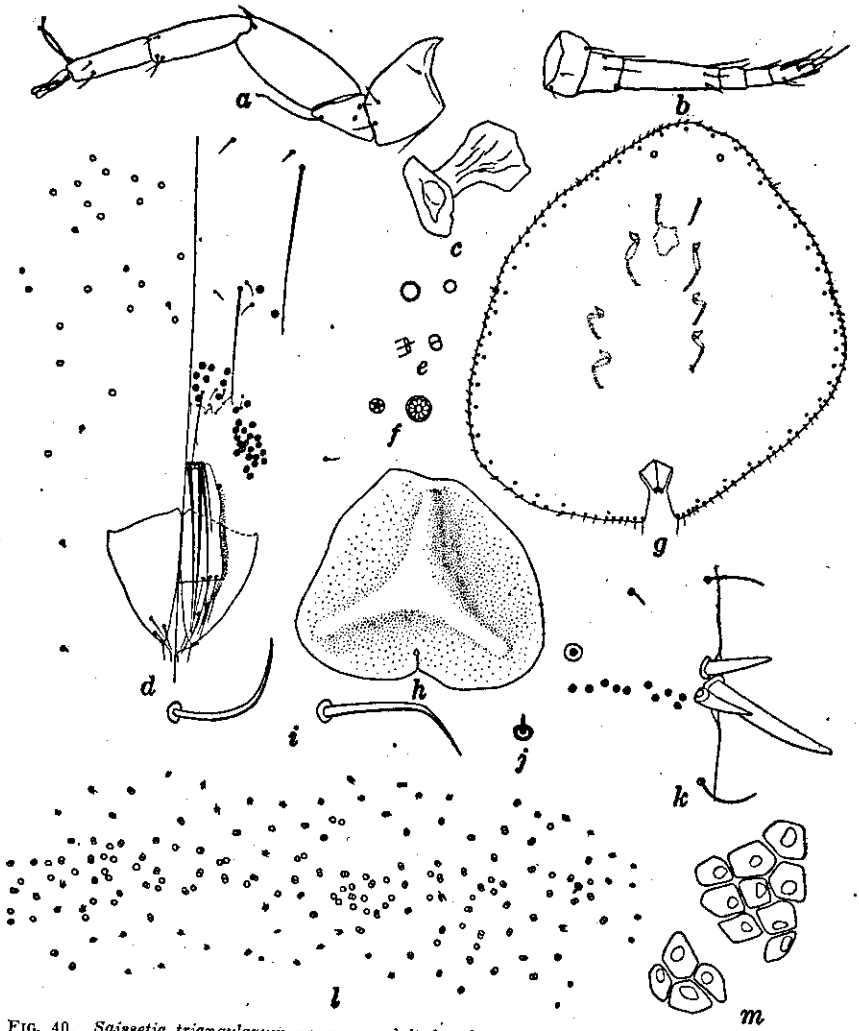

FIG. 40. *Saissetia triangularum* sp. nov., adult female; *a*, leg, × 165; *b*, antenna, × 165; *c*, spiracle, × 335; *d*, anal plate region, dorsal to left, ventral to right, × 165; *e*, some types of dorsal gland pores, × 640; *f*, ventral multilocular pores, smaller from spiracular band, larger from near anal ring, × 640; *g*, outline of body, showing position and relation of various structures, × 29; *h*, outline of body, showing shape and the three central ridges, × 12; *i*, marginal spines, × 640; *j*, dorsal body spine, × 640; *k*, spiracular and marginal spines, × 335; *l*, dorsal median transverse band of double and circular pores, × 335; *m*, derm areolation, × 165.

outer angle sharp and rectangular; with one apical and three dorsal setæ, all apparently easily deciduous from the plates, with three larger setæ on the ventral ridge, with two or three fringed setæ on each side, the latter number apparently commoner; no hypopygial setæ noted; anal ring with eight relatively stout

setæ, one pair of which is much smaller than the others, small, heavy, with a double row of pores on each half.

This species has been described from eight specimens mounted on slides. No satisfactory material of any other stage has been obtainable. The specimens were collected at Paete, Laguna Province, Luzon, on *Cocos nucifera,* May 22, 1917 (*McGregor*). The types are in the United States National collection of Coccidæ.

The small size of this species, its peculiar ridging, and the very numerous submarginal gland tubercles seem to be characteristic, and to separate it from any other member of the genus known to me.

ILLUSTRATIONS

PLATE 1

[All figures on the plate are enlarged 2.5 times.]

FIG. 1. *Icerya aegyptiaca* (Dougl.), adult female.
2. *Icerya seychellarum* (Westw.), adult female.
3. *Drosicha townsendi* (Ckll.), adult female from beneath, before beginning of oviposition.
4. *Tachardia minuta* sp. nov., adult female and young on midrib of leaf.
5. *Rhizococcus philippinensis* sp. nov., adult female and male puparia.
6. *Antonina zonata* Green, adult female in bamboo node.
7. *Pseudococcus virgatus* (Ckll.), adult female.
8. *Pseudococcus filamentosus* (Ckll.), sacs of adult female.
9. *Pulvinaria polygonata* Ckll., adult females.
10. *Vinsonia stellifera* (Westw.), adult females.
11. *Paralecanium expansum quadratum* (Green), adult females, dorsal and ventral surfaces.

TEXT FIGURES

FIG. 1. *Icerya jacobsoni* Green, adult female.
2. *Icerya purchasi* Mask., adult female.
3. *Icerya seychellarum* (Westw.), adult female.
4. *Icerya aegyptiaca* (Dougl.), adult female.
5. *Lophococcus convexus* sp. nov., adult female.
6. *Lophococcus convexus* sp. nov., adult female.
7. *Drosicha townsendi* (Ckll.), adult female.
8. *Asterolecanium bambusæ* (Bdv.) adult female.
9. *Rhizococcus philippinensis* sp. nov., larva and adult female.
10. *Puto spinosus* (Rob.), adult female.
11. *Synacanthococcus bispinosus* g. et sp. nov., adult female.
12. *Phenacoccus hirsutus* Green, adult female.
13. *Pseudococcus virgatus* (Ckll.), adult female.
14. *Pseudococcus virgatus* (Ckll.), adult female.
15. *Pseudococcus sacchari* (Ckll.), adult female.
16. *Pseudococcus filamentosus* (Ckll.), adult female.
17. *Pseudococcus bromeliae* (Bouché), adult female.
18. *Pseudococcus lilacinus* Ckll., adult female.
19. *Antonina zonata* Green, adult female.
20. *Tachardia fici* Green, adult female.
21. *Tachardia minuta* sp. nov., larva and adult female.
22. *Pulvinaria thespesiæ* Green, adult female.
23. *Pulvinaria polygonata* Ckll., adult female.
24. *Pulvinaria tyleri* Ckll., adult female.
25. *Pulvinaria psidii* Mask., adult female.

FIG. 26. *Protopulvinaria longivalvata* Green, adult female.
27. *Vinsonia stellifera* (Westw.), adult female.
28. *Ceroplastes ceriferus* (And.), adult female.
29. *Ceroplastes rubens* Mask., adult female.
30. *Ceroplastodes cajani* (Mask.), adult female.
31. *Coccus diversipes* Ckll., adult female.
32. *Coccus mangiferæ* (Green), adult female.
33. *Coccus viridis* (Green), adult female.
34. *Coccus elongatus* (Sign.), adult female.
35. *Paralecanium luzonicum* Ckll., adult female.
36. *Paralecanium expansum quadratum* (Green), adult female.
37. *Saissetia hemisphaerica* (Targ.), adult female.
38. *Saissetia nigra* (Nietn.), adult female.
39. *Saissetia oleae* (Bern.), adult female.
40. *Saissetia triangularum* sp. nov., adult female.

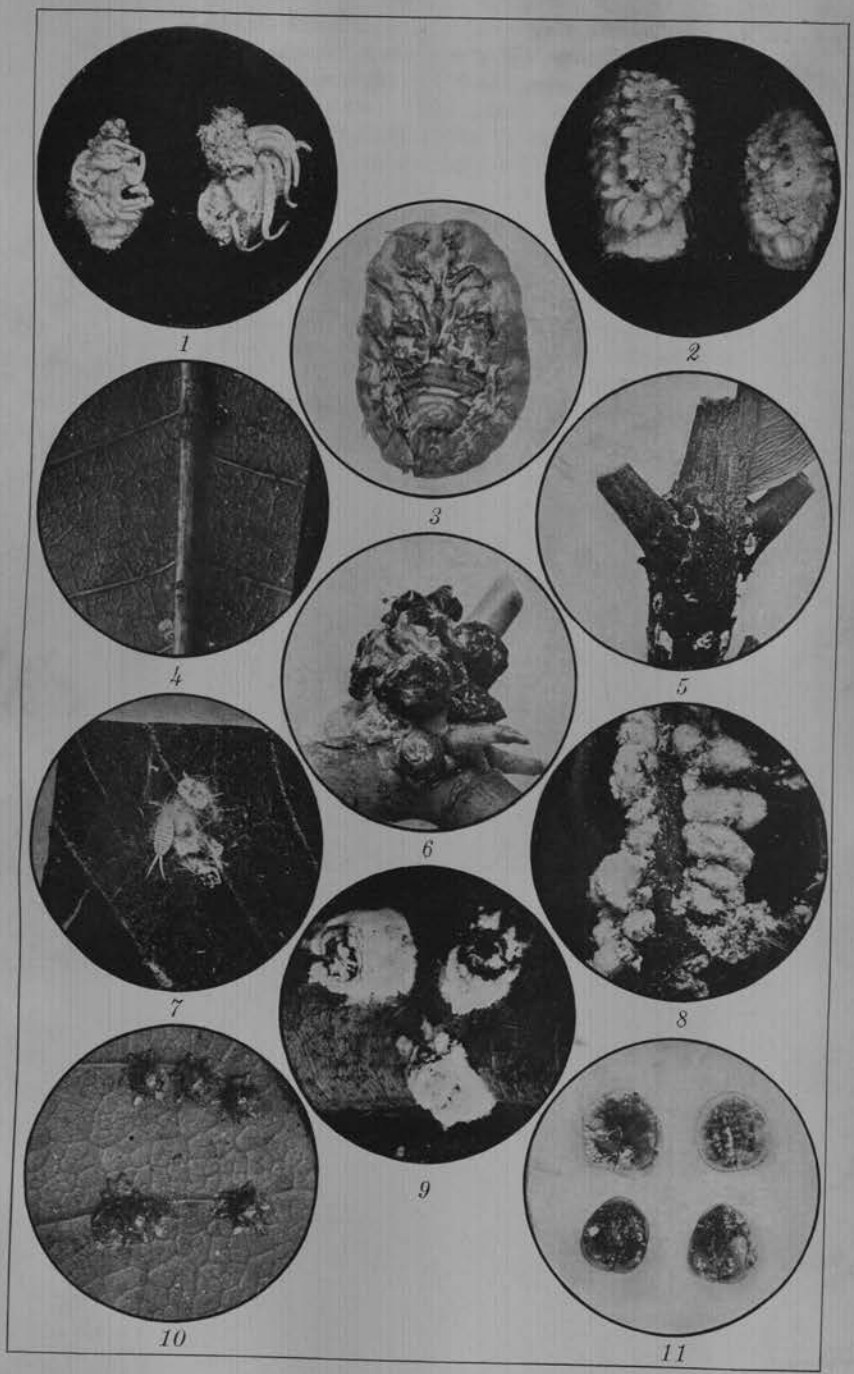

PLATE I. PHILIPPINE NONDIASPINE COCCIDÆ.

SOME THYSANOPTERA FROM THE PHILIPPINE ISLANDS

By H. KARNY

Of Vienna, Austria

FOUR TEXT FIGURES

In this paper, I am publishing a short notice of several Thysanoptera, which Prof. Charles Fuller Baker collected in the Philippine Islands and kindly sent to me for determination, several years ago. In this collection there are two very interesting specimens, each representing a new species; all the other specimens belong to *Dinothrips sumatrensis* Bagnall, a common and widely distributed bark-inhabiting species of the Indo-Malayan Archipelago.

Dinothrips sumatrensis Bagnall. Fig. 1.

This species is represented in the material before me by twenty-five females and seven males from Butuan, Mindanao (leg. *Baker*), one female from Los Baños, and one male from Mount Banahao, all Philippine localities. I have it in my collection also from the type locality, Nias Island, Sumatra, owing to the kindness of Mr. Bagnall; further from Java (leg. *Docters van Leeuwen-Reijnvaan*, under bark), from Perak (ex coll. *Staudinger*) and from Ceylon (*Horn* 1899). From Ceylon this species was described by Schmutz (1913) as *Dinothrips furcifer;* but in the original description of *furcifer* I could not find any distinction from the true *sumatrensis*, and an examination of the type specimen of Schmutz's species in the Vienna Museum—for which I am indebted to the kindnes of Mr. Handlirsch—has made it clear to me that *furcifer* is to be regarded as a synonym of *sumatrensis*. This species is further known from Bengal, Tonkin, and Burma, and through the whole Malayan Archipelago as far as New Guinea.

The coloration of the antenna is very characteristic; it is wholly coal black, only the third joint paler, yellowish, at the end blackish. One of the females in the material before me has the left antenna anomalous. Not only the third joint, but also all following are pale yellowish brown. The antenna seems to be seven-jointed, but a closer examination shows that on

the under surface of the first joint two additional subglobular joints are laterally inserted, forming a short, thick, styliform process (fig. 1). These two additional joints are blackish and have a few setiform hairs. The right antenna of this specimen has the normal form.

The whole surface of the fore femur is covered with a number of spine-bearing pits, as in certain Idolothripidæ. The fore tarsus is armed with a strong tooth, which in the male is subcylindrical and slender, about as long as the tarsus is broad; in the female, triangular and hardly as long as half of the tarsal breadth. The intermediate femora bear before the middle—as Bagnall has already pointed out—a forwardly directed tubercle; but it is very variable in form and size and seems in some specimens to be entirely absent. The anterior angles of

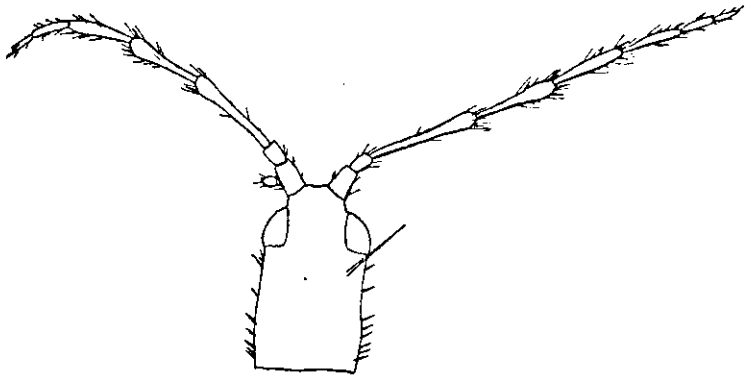

FIG. 1. Head of *Dinothrips sumatrensis*, female, with anomalous left antenna.

the mesonotum are in the male armed with a peculiar bifurcate appendage; in some females, with a small tooth, but usually without it and entirely unarmed.

The coloration of the fore wings is very characteristic. There is near the base close to the fore margin a cloudy dark spot and after it a median, longitudinal, dark brown stripe, which is dilated in the middle of the wing to a smoky, distally evanescent patch. On the hind margin there are about seventy duplicated ciliæ.

Dinothrips monodon sp. nov. Fig. 2.

Dark brownish black. Coloration of antennæ as in *sumatrensis*. Head about twice as long as broad, its greatest width in the basal third. Mouth cone rounded at the end, reaching about half the length of prosternum. Postocular bristles and

cheek spines well defined. Antennal joints of the same form as in *sumatrensis,* each bearing some strong bristles near the middle and before the apex; the two basal and the two apical joints without sense cones; third, fourth, and fifth with one on each side; sixth with only one at the inner margin.

Prothorax transverse, dilated toward the base. Bristles and spines of prothorax and fore coxæ as in *sumatrensis.* Surface of all femora wholly covered with paler, spine-bearing pits. Fore femora strongly incrassate in the male; fore tarsus of the male armed with a very large, somewhat inwardly directed tooth, which is about as long as the tarsus is wide and at base two or more times wider than in *sumatrensis.* Intermediate femora without a conspicuous tubercle.

Mesothoracic appendages not bifurcate, lanceolate, with a sharp outwardly directed tip (fig. 2); on the anterior margin with two, on the posterior with one blunt tooth. Coloration of wings as in *sumatrensis;* hind margin of fore wings with about seventy pairs of fringe hairs. Chætotaxy of abdomen and form of tube as in *sumatrensis.*

Measurements of Dinothrips monodon sp. nov., male.

	Length.	Width.
Antennæ:	*mm.*	*mm.*
First joint	0.11	0.08
Second joint	0.	0.06
Third joint	0.45	0.07
Fourth joint	0.35	0.07
Fifth joint	0.29	0.06
Sixth joint	0.20	0.05
Seventh joint	0.12	0.025
Eighth joint	0.08	0.015
Total length of antennæ	1.7	
Head	0.83	0.42
Prothorax	0.6	[a]1.05
Fore femora	0.85	0.4
Fore tibiæ, including tarsi	0.9	0.17
Pterothorax	1.1	1.4
Middle femora	0.85	0.2
Middle tibiæ, including tarsi	0.95	0.12
Hind femora	1.0	0.18
Hind tibiæ, including tarsi	1.15	0.1
Wing, without fringe	3.5	
Abdomen	4.8	1.25
Tube	0.75	
Tube, at base		0.2
Tube, at apex		0.08
Total length of insect	7.5	

[a] Across fore coxæ.

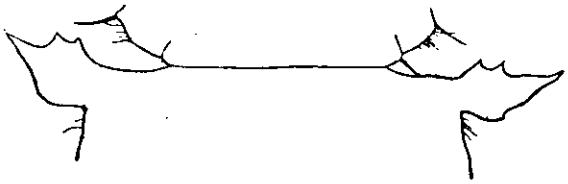

FIG. 2. Mesothoracic appendages of *Dinothrips monodon*, male.

This species is to be distinguished from *sumatrensis* by the form of mesothoracic appendages and of the fore tarsal tooth in the male; but I could not find any other differences, and I am therefore unable to distinguish the females. The description of *affinis* Bagnall from Sarawak I have not yet seen.

MINDANAO, Butuan (leg. *Baker*), 1 male.

Dicaiothrips bakeri sp. nov. Figs. 3 and 4.

Wholly brownish black, fore tibiæ and tarsi paler, yellowish brown, darker, blackish brown along outer and inner margins. Antennæ very dark, coal black, only the third joint paler, yellowish, with the apical third blackish.

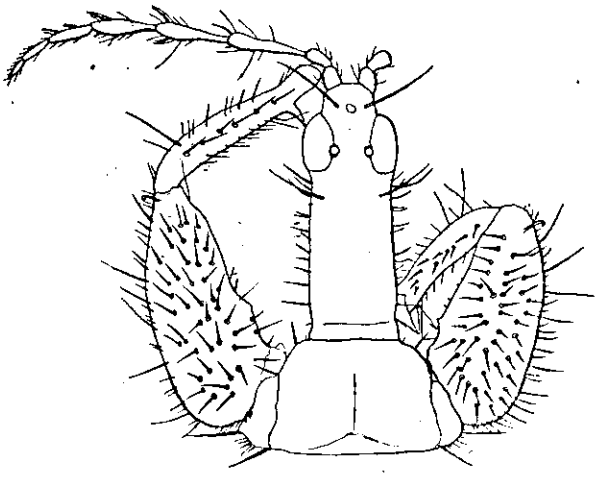

FIG. 3. Head and prothorax of *Dicaiothrips bakeri*, male.

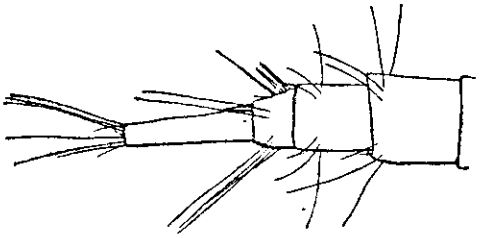

FIG. 4. *Dicaiothrips bakeri*, male; end of abdomen, lateral view.

Head about three times as long as broad, broadest across the eyes, then a little narrowed and again somewhat dilated in the basal quarter, and before the hind margin distinctly collariform and constricted. Cheeks set with numerous strong, sharply pointed spines and long postocular bristles. A pair of very long and strong knobbed bristles occurs near the anterior ocellus. The anteocular processes of the head are a little shorter than wide, with somewhat emarginated sides. Antennæ a little longer than head, bristles and hairs on every joint; especially the third and the fourth joints with a long and strong bristle, behind the middle on the outer (posterior), and near the apex on the inner (anterior) margin. Sense cones (very slender and hardly to be distinguished from the bristles) occur, one on each side of joints 3 and 4 near the apex (that of the outer margin of third joint in my specimen broken off near base); one normally developed on the inner margin of fifth joint, the outer rudimentary; sixth joint with only one sense cone on the inner margin; the two basal and the two apical joints without sense cones. Mouth cone broadly rounded at apex, a little exceeding the middle of prosternum.

Prothorax somewhat transverse, a little dilated posteriorly, including the fore coxæ twice as wide as long; with a sharp longitudinal median line; anterolateral and mediolateral bristles well developed, those of the hind margins still longer and stronger. No toothlike tubercle at the sides of prothorax. Fore coxæ set with a few short spines and a very long and strong bristle on the angle. Fore femora strongly thickened, on the inner margin with a small, blunt tubercle near the base and with a few short spines, on the outer with several longer ones and between these some that are shorter; whole surface covered with numerous spine-bearing pits; near the outer margin before the apex is a strong sickle-shaped bristle. Fore tibæ stout, on each margin set with bristles and spines, especially two or three very long ones on the basal half of the outer margin; the upper surface with a row of spine-bearing pits. Fore tarsi armed with a large triangular tooth.

Pterothorax with somewhat protruding fore margins, distinctly narrowed posteriorly. Intermediate and hind legs relatively long and stout, their femora somewhat thickened, subclavate, set with some strong bristles. Wings clear, not narrowed in the middle, reaching about to the middle of abdomen; the fore pair are, in the basal half, provided with a pale yellowish median longitudinal stripe, in the distal half, with a scarcely

perceptible infumation. On the hind margin of each fore wing there are about forty-five to fifty interpolated ciliæ.

Abdomen long and slender, with the basal segments of subequal length and width, the apical segments longer than broad. Ninth segment strongly narrowed posteriorly, a third the length of the tube; this segment in the basal portion with the margins straight and subparallel, in the apical third a little converging; its breadth at base about one and one-half times its breadth at apex. All abdominal segments near the hind margin set with long bristles; those of the ninth about as long as the tube, those of tube a little shorter. The three basal segments (2 to 4) dorsally with two pairs of well-developed wing-retaining spines, the following without such. On the ventral side of the ninth abdominal segment a pair of long and very thick, straight spines (fig. 4).

I have allowed myself the pleasure of naming this interesting new species after Prof. Charles Fuller Baker, who discovered it in the Philippines.

Measurements of Dicaiothrips bakeri sp. nov., male.

	Length.	Width.
Antennæ:	*mm.*	*mm.*
First joint	0.06	0.06
Second joint	0.09	0.04
Third joint	0.23	0.05
Fourth joint	0.23	0.05
Fifth joint	0.18	0.04
Sixth joint	0.11	0.03
Seventh joint	0.085	0.02
Eighth joint	0.075	0.02
Total length of antennæ	1.06	
Head	0.8	0.28
Prothorax	0.35	[a]0.7
Fore femora	0.75	0.32
Fore tibiæ, including tarsi	0.65	0.09
Pterothorax	0.75	0.8
Middle femora	0.6	0.13
Middle tibiæ, including tarsi	0.65	0.06
Hind femora	0.95	0.1
Hind tibiæ, including tarsi	0.9	0.05
Wing, without fringe	2.0	
Abdomen	2.9	0.55
Ninth segment	0.15	
Tube	0.45	
Tube, at base		0.12
Tube, at apex		0.08
Total length of insect	4.8	

[a] Across fore coxæ.

The new species is to be recognized as a true *Dicaiothrips* by the strong sickle-shaped bristle of the fore femora and differs from the other known species by the coloration of the antennæ. There was only a single idolothripid species hitherto known from the Philippine Islands, *Idolothrips* (?) *tibialis* Ashmead, of doubtful generic position, which is much smaller and has all the tibiæ paler, yellowish. *Dicaiothrips bakeri* belongs to the group with equal third and fourth antennal segments and seems to be closely related to *D. levis* Schmutz, from Ceylon; but this species has the antennæ differently colored and a stouter tuberculated tooth on the fore tarsi of the male. *Dicaiothrips denticollis* Bagnall agrees with *bakeri* by the coloration of the antennæ, but differs by the toothlike process of the prothoracic margins and by its larger size. *Dicaiothrips bruneitarsis* Schmutz has the middle joints of antennæ paler and the fore femora of male much smaller than in *bakeri*. *Dicaiothrips procer* Schmutz differs by its larger size, its shorter vertex, and the coloration of antennæ. *Dicaiothrips greeni* Bagnall has a longer, anteriorly more produced head; light brown middle joints of antennæ, of which the fourth is distinctly shorter than the third; paler middle and hind tibiæ; and differs further by its much larger size. *Dicaiothrips dallatorrensis* Schmutz and *novus* Schmutz have different coloration of antennæ, and the anteocular process of *dallatorrensis* is a little shorter than in *bakeri*. *Dicaiothrips proximus* Bagnall, from Ceylon, is also closely related to *bakeri*, but a little longer and stouter, and has not only the third, but also the basal part of the fourth and the fifth antennal joints yellowish. *Dicaiothrips bouvieri* Vuillet is about twice as long as *bakeri*, has longer antennæ, a more strongly produced vertex, a longer and slenderer fore tarsal tooth, and paler, yellowish, middle and hind tibiæ; the third and fourth antennal joints are equal, as in *bakeri*, while the neotropical species have the fourth distinctly shorter.

PALAWAN, Puerto Princesa (leg. *Baker*), 1 male.

ILLUSTRATIONS

TEXT FIGURES

A VOLUMETRIC METHOD FOR THE DETERMINATION OF LACTOSE BY ALKALINE POTASSIUM PERMANGANATE [1]

By FELIPE T. ADRIANO

Of the Laboratory of Agricultural Chemistry, College of Agriculture, University of the Philippines

Quisumbing,(7) of this laboratory, recently devised a volumetric method for the determination of glucose and starch by alkaline potassium permanganate solution, which is claimed to be shorter than, and as accurate as, any of the Fehling methods, either gravimetric or volumetric. It was thought worth while to apply this method to the determination of lactose in milk. For this purpose a lactose permanganate table similar to that for pure lactose for glucose and starch was prepared. Parallel determinations of lactose in milk were then made by the new, the Soxhlet, and the optical methods. The results show that for the determination of sugar in milk the new method, besides being more rapid, promises to be as accurate as either of the older methods, if not more so.

PREVIOUS WORK ON MILK SUGAR DETERMINATION

So far as can be found in the available literature no quantitative method has ever been devised for the determination of lactose in milk by oxidation with potassium permanganate in alkaline solution. Greifenhagen, König, and Scholl(5) determined the ration of lactose to the amount of oxygen used when the former is oxidized in an alkaline potassium permanganate solution, but they did not work out a method for the determination of this sugar in milk. Some determinations of lactose by the older methods are given here.

[1] This investigation was undertaken at the suggestion and under the direction of Prof. M. L. Roxas. Published with the permission of the Director of the experiment station of the College of Agriculture, University of the Philippines.

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Woll(10) in his report on dairy products gives the following determinations of lactose in condensed milk:

Analyst.	Lactose.	
	By gravimetric method.	By polariscope.
	Per cent.	*Per cent.*
Jaffa and Stewart, California	9.28	9.36
Olson, Wisconsin	9.91	9.19
Jaffa and Stewart, California	8.11	8.00
Do	10.87	10.74
Do	9.96	9.84

He called attention to the fact that the results obtained with the polariscopic method are, in all cases but one, lower than with the copper reduction gravimetric method. His observations were confirmed by the report of Patrick and Boyle(6) who, in their subreport on analysis of dairy products, gave the following results:

Sample No.	Lactose.	
	By Soxhlet method.	By polariscope.
	Per cent.	*Per cent.*
2930 (Referee's sample)	10.04	10.07
2530	10.51	10.19
2528	10.69	10.57
2610	10.15	9.97
2529	9.20	8.71
2531	9.37	9.00

Folin and McEllroy(4) have recently succeeded in introducing copper phosphate mixtures, the alkaline phosphate taking the place of tartrates, citrates, or glycerol in the analysis of sugars in urine, using a modified Benedict titration method. Folin and Denis(3) have applied this method to the determination of lactose in milk and they claim that it gives accurate results. Their method as applied to milk is remarkably simple, for it does away with the preliminary preparation of protein-free filtrates, since albumin does not interfere with the titration, and it therefore "eliminates the cumbersome 'corrections' for the volume occupied by the protein-fat precipitates." In

the same paper a picrate colorimetric method for lactose is described which is materially simpler than the one given by Dehn and Hartman.(2) Parallel results obtained with the colorimetric method of Folin and Denis and the titration method are given to show that the latter is the more accurate.

MATERIALS AND PROCEDURE

QUISUMBING'S(7) METHOD AS APPLIED TO THE DETERMINATION OF LACTOSE IN MILK

Place in an Erlenmeyer flask 50 cubic centimeters of 0.1 *N* potassium permanganate solution, 25 cubic centimeters of a solution of sodium carbonate containing 8.48 grams of (anhydrous) sodium carbonate per liter and 5 or 10 cubic centimeters of the filtrate obtained as indicated below. Add sufficient water to make the final volume of the mixture 100 cubic centimeters. Heat the mixture on the heating device, consisting of an iron tripod with asbestos hood, with the heating power so regulated that its temperature is raised from 29° C. to 95° C. in two minutes, and continue heating for another two minutes after the temperature has reached 95° C. Remove the flask and add gradually 25 cubic centimeters of 30 per cent sulphuric acid and 0.1 *N* oxalic acid solution until the liquid is clear. Titrate the excess of oxalic acid against standard 0.1 *N* potassium permanganate solution, adding the latter until the liquid assumes a pink color that remains for a few seconds. The sum of the number of cubic centimeters of 0.1 *N* potassium permanganate solution used in oxidation and in titration minus the number of cubic centimeters of 0.1 *N* oxalic acid solution gives the number of cubic centimeters of 0.1 *N* potassium permanganate solution that is actually used in oxidation The corresponding lactose value with the use of pure lactose is shown in Table 2.

The pure lactose used in obtaining the data for this table was prepared as follows:

To an alcoholic solution, saturated at 40° C. of chemically pure lactose obtained from a local dealer, absolute alcohol and ether were added, and the sugar was allowed to crystallize from the solution in a vacuum desiccator over sulphuric acid. When about half of the solvent had evaporated, the crystals were separated from the mother liquor by suction and then washed with small amounts of ether and absolute alcohol. The lactose was recrystallized three times in the manner described and the purified product dried for sixteen hours at 40° C. under

vacuum in an apparatus similar to that described by Browne.(1) Its purity was determined, as follows:

1.6450 grams of the pure lactose were weighed and dissolved to 100 cubic centimeters. Twenty-five cubic centimeters of this solution were analyzed by the Soxhlet method for the lactose content, and a portion was polarized after having been allowed to stand for twenty-four hours.

TABLE 1.—*Determination of the purity of lactose.*

Method of analysis.	Lactose. Per cent.
Optical method	100.00
Soxhlet method	99.98
Average	99.99

TABLE 2.—*Determination of lactose by the alkaline potassium permanganate method.*

Lactose.	0.1 *N* $KMnO_4$.	Lactose.	0.1 *N* $KMnO_4$.	Lactose.	0.1 *N* $KMnO_4$.	Lactose	0.1 *N* $KMnO_4$.
mgs.	*cc.*	*mgs.*	*cc.*	*mgs.*	*cc.*	*mgs.*	*cc.*
1	2.51	11	12.30	21	23.63	31	34.65
2	3.21	12	13.80	22	24.87	32	35.69
3	4.04	13	15.41	23	25.92	33	36.16
4	4.39	14	16.72	24	26.67	34	37.26
5	5.47	15	17.85	25	28.10	35	38.26
6	6.52	16	19.04	26	28.39	36	38.64
7	7.69	17	20.16	27	29.50	37	39.28
8	9.13	18	20.96	28	30.60	38	40.16
9	9.98	19	21.50	29	31.49	39	40.56
10	11.37	20	22.89	30	32.55	40	41.47

APPLICATION OF THE NEW METHOD TO THE ANALYSIS OF LACTOSE IN MILK

The milk under examination was analyzed for its lactose content by means of the optical method, the gravimetric method, and the new method, thus making possible a comparison of the results of the three methods. That the milk samples should all be of equal concentration, the evaporated canned milk was diluted by mixing equal parts of the milk and water before proceeding with the analysis. To determine which of the methods is the most accurate, similar analyses were made on "synthetic" milk prepared as indicated below. The preparation of the solution used for the gravimetric method and the new method is as follows:(8)

Dilute 25 cubic centimeters of milk of known weight with 400 cubic centimeters of distilled water in a 500 cubic centimeter graduated flask. Add 10 cubic centimeters of the cop-

per sulphate [2] solution and 8.8 cubic centimeters of 0.5 sodium hydroxide solution. After the addition of the alkali the mixture must still have an acid reaction and contain copper in solution. Fill the flask to the 500 cubic centimeter mark; mix, filter through a dry filter, and determine the lactose in the filtrate, taking 50 cubic centimeters for the copper reduction and 10 cubic centimeters for the alkaline potassium permanganate method.

For the optical method the directions given in Sherman's Organic Analysis(9) were followed.

The results of the analysis performed on canned and on fresh cows' milk are as follows:

TABLE 3.—*Determination of lactose in milk.*

[Figures express the percentages of lactose by weight.]

Sample.		Lactose.		
No.	Description.	Polariscope.	Quisumbing's method.	Soxhlet's method.
		Per cent.	*Per cent.*	*Per cent.*
1	Sterilized Norway natural milk	4.60	5.21	5.65
2	Do	4.56	5.20	5.64
	Average	4.580	5.205	5.645
3	Sterilized evaporated milk	6.12	9.52	9.76
a4	Do	8.26	9.88	10.08
a5	Do	7.28	9.70	9.88
a6	Do	7.22	9.84	9.86
	Average	7.220	9.735	9.895
7	Evaporated milk	8.71	9.98	10.30
8	Do	8.78	9.99	10.24
9	Do	8.72	9.94	10.30
10	Do	.....	9.94	10.29
	Average	8.736	9.962	10.282
11	Sterilized natural milk	4.41	4.50	4.52
12	Do	4.42	4.46	4.62
13	Do	4.38	4.53	4.46
14	Do	4.38	4.46	4.73
	Average	4.395	4.487	4.582
15	Cows' milk from Los Baños	4.50	4.80	5.08
16	Do	4.48	4.79	5.06
	Average	4.490	4.795	5.070

[a] These samples were taken from the same can as No. 3, but they were treated with varying amounts of pure lactose. The percentage of lactose added was subtracted to find the true percentage of lactose in the milk.

[2] Dissolve 34,639 grams of copper sulphate in 100 cubic centimeters of water and dilute to 1 liter.

ANALYSIS OF SYNTHETIC MILK

For the purpose of determining which of the three methods will give the most accurate results, analyses were made of "synthetic" milk, which was prepared in the laboratory by mixing:

	Per cent.
Water	87.75
Fat (in the form of butter)	3.40
Protein (in the form of casein)	3.50
Pure lactose	4.60
Mineral substances from the ash of canned milk	0.75

The results are shown in Table 4.

TABLE 4.—*Analyses of synthetic milk.*

Sample No.	Lactose.		
	Polariscopic method.	Quisumbing's method.	Soxhlet's method.
	Per cent.	*Per cent.*	*Per cent.*
1	4.24	4.78	4.80
2	4.16	4.77	4.80
Per cent of lactose added	4.60	4.60	4.60

DISCUSSION OF RESULTS

Table 2 gives the milligrams of lactose corresponding to the number of cubic centimeters of 0.1 *N* potassium permanganate solution used in the determination as described. Table 3 shows the results of the analysis of the different samples of milk by the three methods. Table 4 gives the results with synthetic milk with a known percentage of lactose. From these tables it may be seen that the percentage of milk sugar given by the optical method is consistently lower than by the Quisumbing or the Soxhlet method, and also that the Quisumbing method gave lower results than did the Soxhlet. The differences between the polariscopic method and the two oxidation methods are in most cases serious, whereas the oxidation methods may be considered to agree closely. The differences between the polariscopic method and the two oxidation methods are greater in the case of the sterilized evaporated milk than in that of the sterilized natural milk or the fresh cows' milk (see Table 3). It was thought that the differences might be due to changes in the sterilized evaporated milk that occur during manufacture but which do not occur in the sterilized natural milk or in the fresh cows' milk, and that such changes resulted in the formation of

soluble products not precipitated by acid mercuric nitrate. The proteins or milk are most susceptible to hydrolysis during the process of evaporation, and would give rise to optically active products which may not be precipitated by mercuric nitrate. To test this point the filtrates from samples 7 to 10, 11 to 14, and 15 and 16 (Table 3) were analyzed for their nitrogen content by the Kjeldahl Gunning Arnold(8) method with the following results:

TABLE 5.—*Nitrogen determination of filtrates from samples 7 to 10, 11 to 14, 15 and 16 (Table 3).*

Source of sample.	Nitrogen in samples—		
	7 to 10.	11 to 14.	15 and 16.
	Per cent.	*Per cent.*	*Per cent.*
Filtrate for the polariscopic method	0.0110	0.0130	0.0021
Calculated as milligrams alanin in 100 cubic centimeters of filtrate	70.00	82.50	12.70
Filtrate for the reduction methods	0.0006	0.0056	0.0016

These results show that hydrolysis of the protein occurs in the process of evaporation and sterilization of milk. Thus the fresh cows' milk gives less nitrogen in the filtrate than either the evaporated or the sterilized milk. The differences are clearly seen if the nitrogen is expressed in milligrams of a dipeptid or an amino acid such as alanin. Of course, nothing is known of the nature of these nitrogenous compounds. But, judging from the results of the analysis of samples 7 to 10, where the average difference between the polariscopic method and the two oxidation methods is greater than 1 per cent, and of samples 11 to 14, where the optical and the oxidation methods agree to within 0.1 per cent—both giving almost the same percentage of nitrogen in the filtrate—these soluble products may influence the rotation of lactose in either direction. It is very likely that other factors have an influence on the specific rotation of this sugar. This seems to be indicated by the results with synthetic milk. The casein used in the preparation of the latter must have been completely reprecipitated together with the fat by the acid mercuric nitrate, since hydrolysis of the casein was hardly possible under the conditions of the experiments; and yet the results of the sugar analysis by the polariscopic method are much lower than by the oxidation methods. Of course, no definite conclusions can yet be drawn from the results of only one set of experiments, but there are some indications

that the mercuric nitrate, the ash, or the nitric acid, or all three, affect also the specific rotation of lactose. The influence of the factors seems to be cumulative in the case of the evaporated milk and compensating in the case of the sterilized milk.

SUMMARY AND CONCLUSIONS

The attempt to apply the alkaline potassium permanganate method to the determination of lactose in milk has met with success. This method has advantages over the older methods in rapidity and accuracy. Lactose determinations run with the new method give consistently lower results than with the Soxhlet method.

The results obtained by the polariscopic method are very unreliable and cannot be used for accurate work, especially in the analysis of canned milk. Where a high degree of accuracy in the results is required the Quisumbing or Soxhlet method should be given preference.

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SOME BEES FROM SANDAKAN, BORNEO

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Borneo undoubtedly possesses a very large bee fauna, as yet imperfectly known. Collections from different widely separated localities furnish different species; and, while it is not yet possible to reach definite conclusions, there are some indications that there may be greater specific diversity in different parts of Borneo than in the Philippines, in spite of the fact that the latter area is divided into many islands. Sandakan, in North Borneo, is only about 250 miles from Mindanao; but its fauna appears to be very different in many respects from that of the Philippines. Especially striking is the great abundance and variety of *Trigona*, a genus represented by few species in the Philippines and, so far as we yet know, not present on Mindanao at all. Another remarkable fact is the presence of the genus *Heterapis* at Sandakan, a genus of minute and very peculiar bees, previously known only from three Australian species.

All the Sandakan material was received from Prof. C. F. Baker.

Genus NOMIA Latreille

Nomia strigata (Fabricius).

The specimens from Sandakan appear to represent a single species, but the variations are very striking, as follows:

Variety *a*. Abdominal bands bright emerald green suffused or shot with brilliant violet. Female, *Baker 9614;* male, *Baker 9613*.

Variety *b*. Larger than *a;* fourth band as in *a*, the others yellower green, without violet. Female.

Variety *c*. All the bands bright yellowish green suffused with pale vermilion. Male. This is variety *ridleyi* (Cockerell), already known from Singapore, Java, and the Philippines.

Nomia iridescens Smith.

One female of variety *rhodochlora* Cockerell, described from Mindanao and Negros. The first two abdominal segments entirely lack the metallic color seen in a specimen of *N. iridescens* from F. Smith's collection.

Nomia tuberculifrons sp. nov.

Female.—Length, a little over 10 millimeters; black, with four rather broad, very bright, emerald green bands (slightly tinged with red) on abdomen; legs ferruginous, with pale fulvous hair; wings dilute reddish fuliginous, the second submarginal cell large and square; supraclypeal area with a strong elevation or tubercle, representing the lower end of the frontal keel; clypeus shining, sparsely and not strongly punctured, reddish apically, depressed in middle, wholly without a keel, but with a low elevation or boss on each side; head and thorax with pale fulvous hair; mesothorax and scutellum with thin inconspicuous hair; mesothorax dullish and practically impunctate, except the disc posteriorly, which is shining and evidently punctured; scutellum slightly bigibbous, the bosses shining; postscutellum unarmed; tegulæ fulvous. Antennæ strongly reddened on underside. Hair of abdomen above, except basally, black, but on underside pale fulvous.

BORNEO, Sandakan, 2 females. This belongs to a little group of species which includes *N. elegans* Smith, *N. borneana* Cameron, and *N. erythropoda* Cameron. *Nomia elegans* differs by the hyaline wings and blue-green abdominal bands. (A specimen from Celebes, standing in the British Museum as *N. elegans*, differs from Smith's description, having the abdominal bands yellow-green shot with vermilion.) *Nomia borneana*, based on a female collected by Shelford, differs by the hyaline wings with pale nervures, but agrees in the tubercle on face. Cameron says that *borneana* is close to *elegans*, which may be known from it by the clypeus being coarsely punctured, subtuberculate on each side, and with a central longitudinal depression. Our insect has the clypeus as here described for *elegans*, except that it is sparsely and not very coarsely punctured. *Nomia erythropoda*, based on a male from Kinghang, has no bright-colored band on first abdominal segment; the wings are hyaline, with the radial and cubital cells smoky; the lower part of front and face are keeled in the center. According to Meade-Waldo, *erythropoda* and *borneana* are the same species.

The following key will be useful for the separation of the Bornean species of *Nomia:*

Wings dark violaceous; female, 12 millimeters long (Kuching).
violaceipennis Cameron.

Wings hyaline or smoky (fusco-violaceous at apex in *robusta*)..... 1.

1. Abdomen clavate; legs rufotestaceous; male (Sarawak).
ceratina (Smith).
Abdomen not clavate ..... 2.
2. Large species (14 millimeters long); apices of abdominal segments with fulvous hair bands; female ..... robusta Cameron.
Smaller, 11 millimeters or less ..... 3.
3. Yellow-orange, with black or blackish marks, abdomen with eight dark spots; wings clear, slightly dusky, nervures yellow; scutellum bigibbous; male, 8 millimeters long (Liangtelan) ..... gribodoi Vachal.
Abdominal segments with pubescent bands; female, 7 millimeters long (Bidi) ..... bidiensis Cameron.
(*N. bicarmata* Cameron, misprint for *bicarinata*, was based on specimens from Kuching. Meade-Waldo states that a specimen labeled *bicarinata* by Cameron is identical with *bidiensis*. According to the descriptions, the stigma is pale testaceous in *bidiensis*, fuscous in "*bicarmata*.")
Abdomen with three cream-white bands; much of the abdomen red; female, 8 millimeters (Bidi, Sarawak) ..... leucozonata Cameron.
Abdomen with blue or green bands ..... 4.
4. Legs fulvous ..... 5.
Legs black ..... 6.
5. Wings hyaline; female, 11 millimeters; male, 9 to 10 millimeters.
borneana Cameron (erythropoda Cameron).
Wings reddish fuliginous ..... tuberculifrons Cockerell.
6. Thorax densely covered with fulvous pubescence; male, 11 millimeters.
varibalteata Cameron.
Thorax not thus covered with fulvous hair; clypeus keeled ..... 7.
7. First abdominal segment with a blue or green band.
strigata (Fabricius).
First segment without such a band ..... iridescens Smith, var. rhodochlora Cockerell.

Genus APIS Linnæus

Apis indica sinensis (Smith).

The single worker before me agrees best with the Chinese subspecies, *sinensis*. It differs a little in wholly lacking bands of gray tomentum at bases of abdominal segments 3 to 5 and in the clear yellow scutellum. The dark hair on the front is very long and abundant. Possibly a Bornean race may be recognized when we have more material.

Apis florea Fabricius and *A. dorsata* Fabricius were also found at Sandakan.

Genus NOMADA Scopoli

Nomada sandacana sp. nov.

Male.—Length, about 5 millimeters; bright ferruginous, with the region of the ocelli and two large triangular marks on first

abdominal segment black; head broad, eyes green; mandibles simple; antennæ very long; scape long and swollen, bright red; flagellum black, obscurely reddish beneath; third antennal joint long, equal to fourth; mesothorax dull; scutellum presenting two large brighter red spots, close together; base of metathorax largely shining; tegulæ red; wings dusky on apical margin; stigma and nervures dark brown; basal nervure going basad of transverse median; three submarginal cells, second receiving recurrent nervure in middle; abdomen broad, shining, apical plate deeply notched; legs red, the hind femora with a dark mark above near end.

BORNEO, Sandakan. Nearest to *N. testaceobalteata* Cameron from Kuching, Borneo, but easily known by the almost entirely red color, like that of a female. It is very distinct from all the Philippine species.

Genus **MEGACHILE** Latreille

Megachile tarsatula Cockerell.

A female from Sandakan (*Baker 9969*) does not differ from those collected in the Philippines (Mindanao, Palawan, and Negros).

Genus **PROSOPIS** Fabricius

Prosopis opacissima Cockerell.

Male.—Length, about or nearly 5 millimeters; not very robust; black, with the following parts lemon yellow: Clypeus, cuneiform lateral face marks (filling space between clypeus and eye, and ending broadly but obliquely above at antennæ), labrum except margin, greater part of mandibles, interrupted band on prothorax (not nearly reaching tubercles), tubercles, spot on tegulæ, anterior tibiæ except a large spot behind, basal half of middle and hind tibiæ, and all the tarsi (small joints rufescent). Eyes strongly converging below, so that lower part of face is narrowed; antennæ long, scape with a yellowish stripe, flagellum dusky ferruginous beneath; front densely and minutely punctured; mesothorax dull and densely punctured; scutellum with larger less-crowded punctures; area of metathorax with transverse sulci, the whole effect resembling the picture of a bird in flight; wings dusky, stigma and nervures dark, first recurrent nervures meeting first transversocubital; abdomen shining on first two segments, with excessively fine punctures,

third and following segments dull; sides of first segment with small fringes of white hair (*Baker 9985*).

Female.—Like the male, but face marks reduced to three; namely, a very broad band on clypeus (sometimes rounded, sometimes slightly emarginate, above), and lateral face marks; the latter keeping the cuneiform shape, but separated from the clypeal mark, and their lower ends scarcely going down as far as middle of clypeal band (*Baker 9987*).

BORNEO, Sandakan; 1 male, 4 females. The male is extremely close to *P. taclobana* Cockerell, from Leyte; but the mesothorax is more coarsely sculptured, the wings are browner, and there is less yellow on the scape. I cannot separate the female from the Philippine *P. opacissima,* which has hitherto been known only in that sex.

Prosopis borneensis sp. nov.

Female.—Length, about 6 millimeters, robust; black, with yellow markings as follows: Large cuneiform mark on clypeus (the point upward), broad-triangular lateral face marks (filling space between clypeus and eye, and ending on the orbits at an angle of about 45 degrees, a little above level of antennæ), interrupted band on prothorax (not nearly reaching tubercles), tubercles, large spot on tegulæ (which are piceous posteriorly), and all the tibiæ at base (the anterior and posterior ones broadly, the middle slightly). Tarsi black; mandibles with a subapical spot; antennæ black, flagellum ferruginous beneath apically. Face broad; front dull; mesothorax distinctly and very densely punctured, posterior middle more shining and not so closely punctured; scutellum shining, and with large punctures; base of metathorax with rugæ forming an irregular reticulation; sides of metathorax pruinose with fine pale pubescence; wings hyaline, slightly dusky, stigma and nervures black; first recurrent nervure meeting first transversocubital; second submarginal cell broad; abdomen shining, hind margins of segments laterally with fine pruinose pubescence. The apical ventral segment is sheathlike, inclosing the sting.

BORNEO, Sandakan. Related to *P. mindanensis* Cockerell, from Mindanao. Only the male of *mindanensis* is known, but the Bornean insect has the wings distinctly brownish, and the scutellum and posterior part of mesothorax less densely punctured, so I think it is certainly distinct. The lateral face marks of *mindanensis* have the upward extension linear instead of broadly angular.

Proposis hewittii Cameron, from Borneo, is an *Allodape*.

Genus **ALLODAPE** Lepeletier

Allodape hewittii (Cameron) var. sandacanensis var. nov.

Meade-Waldo considered the *Prosopis hewittii* Cameron, from Kuching, to be *Allodape marginata* Smith. It differs, however, in being much smaller, and having the face mark (female) as in *A. sauteriella* Cockerell, from Formosa. The present insect agrees with Cameron's description, except that the face mark and tubercles are ivory color instead of lemon yellow, the light band on prothoracic margin consists only of white pubescence, and the palpi are not black. The thin hair on abdomen above is not all blackish. Part of the difference may be due to error in Cameron's description, but we seem to have at least a distinct variety (*Baker 9979*).

Allodape marginata Smith.

One female, with more glistening pale hair on the last three abdominal segments than in the Luzon form.

Allodape cupulifera Vachal.

Six females; a variable lot, but apparently all one species (*Baker 9978, 9980*).

Genus **HERIADES** Spinola

Heriades bakeri sp. nov.

Female.—Length, 6 millimeters; black, of the usual form; clypeus simple; mandibles with two large teeth, and the inner corner approximately rectangular; a broad band of dense white hair along each inner orbit; antennæ black; tubercles densely fringed with pure white hair; tegulæ black; wings conspicuously dusky; first three abdominal segments with narrow but conspicuous white hair bands; ventral scopa white.

BORNEO, Sandakan (*Baker 9971*). Very much like *H. sauteri philippinensis* Friese, from the Philippine Islands (Luzon), but easily known by the smaller punctures of mesothorax. In typical *H. sauteri* from Formosa these punctures are about 50 microns wide; in *philippinensis*, about 35; in *bakeri*, 24 to 30. In the new species *bakeri* the wings are conspicuously darker than in the variety *philippinensis*.

Heriades fulvescens sp. nov.

Male.—Length, about 4.2 millimeters; black, of the usual form. I at first took it for granted that this was the male of

bakeri, but this cannot be, as the mesothorax has large punctures like those of *H. sauteri*, the wings are clear, and the hair at sides of face, on scutellum, etc., is pale fulvous. The antennæ are slender, but not so long as in *H. othonis* Friese, from Java. The upper part of truncation of mesothorax is polished and brilliantly shining.

BORNEO, Sandakan (*Baker 9972*). The second submarginal cell is shorter than in the European *H. truncarum* (Linn.), and the second recurrent nervure joins it very near the end.

Genus CERATINA Latreille

Ceratina collusor Cockerell, variety *a*.

Male.—Nearly agrees with type from Singapore, differing in that the scape has only one yellow spot (the lower one), and there are some punctures between the parapsidal grooves and the lateral yellow lines on mesothorax. Those may represent mere individual variation.

Female.—Like *C. philippinensis nigrolateralis* Cockerell, from Palawan, but differing thus: Labrum with a yellow spot; upper part of clypeal mark much larger and broader, emarginate at upper end; second submarginal cell smaller; first abdominal segment with a broad yellow hind margin, on which are two black spots; band on second segment entire, on third narrowly interrupted. There is no yellow spot behind the tubercles. The bands at sides of face are long. The hind tibiæ are yellow at base, and have a small sharp spine on outer side near end of first third. There is a similar spine in *nigrolateralis*.

BORNEO, Sandakan (*Baker 9973*). *Ceratina collusor* was described from the male, *nigrolateralis* from the female, but they are evidently very closely allied. The Bornean insect is *collusor;* perhaps a slightly modified race.

Ceratina flavonitens sp. nov.

Male.—Length, about 5.5 millimeters; shining, black, with the following parts bright chrome yellow: Labrum, mandibles, broad band behind whole length of eyes, clypeus except narrow band on each side, subtriangular supraclypeal mark, spots on front, inner orbits to vertex (the upper half of the band slender), prothorax with tubercles, mesopleura (black in front), metathorax (basal middle black), four stripes on mesothorax, scutellum, postscutellum, legs except hind tibiæ (which are black, with base and apex yellow), first abdominal segment except two very large black marks, bands on segments 2 to 6, and

entire middle of sixth. Venter yellowish except apically. Face narrow, polished; flagellum dark, only moderately long; mesothorax smooth and polished, punctured anteriorly; tegulæ rufotestaceous; wings strongly reddened; stigma long, piceous; apical plate of abdomen fulvous-margined, broadly rounded, obtusely subangulate at sides, faintly subangulate in middle, but wholly without a salient point.

BORNEO, Sandakan. Readily known from *C. flavopicta* Smith, from Sarawak, by the smaller size and yellow pleura. It is perhaps nearest to the much larger *C. ridleyi* Cockerell, but differs in a number of characters.

BEES PREVIOUSLY RECORDED FROM SANDAKAN

BAKER COLLECTION

Xylocopa collaris Lepeletier.
Megachile facetula Cockerell.*
Megachile sandacana Cockerell.*
Megachile atrata fulvipennis (Smith).
Dianthidium meliponiforme Cockerell.
Anthophora borneensis (Cockerell).
Anthophora zonata andrewsi (Cockerell.)
Crocisa angulifera Cockerell.*
Crocisa crucifera Cockerell.
Ceratina sexmaculata Smith.
Heterapis sandacanensis Cockerell.*
Trigona melanotricha Cockerell.*
Trigona rufibasalis Cockerell.*
Trigona melina Gribodo.
Trigona apicalis Smith.
Trigona ambusta Cockerell.
Trigona busara Cockerell.
Trigona melanocephala Gribodo.
Trigona geissleri Friese (var. *a*).
Trigona sandacana Cockerell.*
Trigona hæmatoptera Cockerell.*
Trigona breviceps Cockerell.*
Trigona trochanterica Cockerell.*
Trigona fuscibasis Cockerell.*
Trigona scintillans Cockerell.*
Apis florea andraeiformis (Smith).

Sandakan is the type locality of those marked with an asterisk. The Sandakan bees seen by me include fourteen genera and forty-two species. One of the genera (*Heterapis*) has not been found in the Philippines. Of the species, only twelve are also known from the Philippines, and in two of these the Sandakan insect is a distinct variety. The species described as new from Sandakan number nineteen.

Hewitt sent Cameron many bees from Sarawak. None of the new species described by Cameron are in the Sandakan collection, except *Allodape hewittii*, which is represented by an apparently distinct variety.

One would expect to find resemblance between the Sandakan fauna and that of Palawan. The bees known from Palawan are the following; those marked with an asterisk are not known from any other island:

BEES RECORDED FROM PALAWAN

Prosopis palavanica Cockerell.*
Halictus philippinensis Ashmead.
Halictus caroli Cockerell.*
Nomioides valdezi Cockerell.
Nomia quadrifasciata notha (Cockerell).
Nomia strigata (Fabricius).
Nomia lusoria Cockerell.*
Nomia elongatula Cockerell.
Nomia palavanica Cockerell.*
Nomada palavanica Cockerell.*
Dianthidium minutissimum (Bingham).
Megachile tarsatula Cockerell.
Megachile philippinensis Friese.
Ceratina philippinensis Ashmead.
Ceratina philippinensis nigrolateralis Cockerell.*
Ceratina humilior (Cockerell).*
Ceratina fuliginosa Cockerell.*
Xylocopa nigrocoerulea Smith.
Xylocopa fuliginata Pérez.
Xylocopa mimetica Cockerell.*
Mesotrichia amauroptera (Pérez).*
Mesotrichia sulcifrons (Pérez).*
Mesotrichia vachali (Pérez).*
Mesotrichia latipes basiloptera Cockerell.*
Trigona palavanica Cockerell.*
Trigona luteiventris Friese.
Apis florea rufiventris Friese.

Thus Palawan has twenty-six recorded species, about half not known elsewhere. Only three of these species are in the Sandakan list, and two of these occur elsewhere in the Philippines. The third, *Apis florea,* is represented by a distinct variety. *Dianthidium,* a genus found at Sandakan, is recorded in the Philippines only from Palawan. Palawan has two species of *Trigona,* while only a single species is known from elsewhere in the Philippines. Although these lists are very incomplete, it is evident that the bee fauna of Palawan is not closely related to that of Sandakan. About a quarter of the Sandakan species are known from the Philippines, excluding Palawan. About a third of the Palawan species are known from other Philippine Islands, but it is possible that some of these, nesting in wood or stems of plants, may have been accidentally introduced by man. The present indications are, then, that the bee fauna of Palawan is largely endemic, and has more resemblance to that of the other Philippine Islands than to that of North Borneo.

NEW PHILIPPINE GALL MIDGES

By E. P. Felt

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The present account, based on a small collection of gall midges recently at hand, is a continuation of previous studies.[1]

The five species in this lot reveal the presence in the Philippines of the European *Stenodiplosis geniculati* Reut., known also from New Zealand and recorded from the last locality as seriously damaging the developing seed of *Alopecurus pratensis.* The Philippine record indicates a probable wide distribution of this species, and its being reared in the Islands from panicles of *Panicum crus-galli* Linn. suggests that this midge may develop in the seeds of various grasses.

The occurrence of a species presumably congeneric with a peculiar South American form is of more than ordinary interest, especially as we have no record of *Scheueria* from other parts of the world. It should also be pointed out that known species of *Toxomyia* are fungivorous, and in view of this it may be demonstrated later that the two females referred to this genus really developed from fungus-feeding larvæ rather than from gall producers.

This small collection was received through the courtesy of Mr. Leopoldo B. Uichanco, of the department of entomology, College of Agriculture, University of the Philippines.

Scheueria scheffleræ sp. nov.

Female.—Length, 1.25 millimeters. Antennæ extending to base of abdomen, rather thickly haired, dark brown, of 17 segments, the first broadly obconic, the second globose, the third and fourth narrowly fused, the fifth with a length one-fourth greater than its diameter, sparse basal and subapical whorls of long, stout setæ and low circumfila united by transverse fila near the basal third, and subapically. Terminal segment somewhat produced, broadly oval, with a length about twice its diameter. Palpi uniarticulate, the one segment broadly, irreg-

[1] Felt, E. P., New Philippine Gall Midges with a Key to the Itonididæ, Philip. Journ. Sci. § D 13 (1918) 281; 14 (1919) 287.

ularly oval and sparsely setose. Eyes holoptic. Mesonotum fuscous yellowish. Scutellum pale yellowish. Postscutellum a little darker. Abdomen rather thickly haired, reddish brown. Wings, with the costa dark brown, the membrane rather thickly scaled. Subcosta unites with costa at the basal third, the third vein just before the apex of the wing, the fifth at the distal third, its branch near the basal third. Halteres yellowish basally, fuscous apically. Coxæ reddish brown. Femora and tibiæ mostly yellowish brown. Tarsi dark brown or black. Claws moderately stout, strongly curved, unidentate, the pulvilli as long as the claws. Ovipositor stout, with a length about one-fourth of abdomen, the terminal lobes broadly and roundly triangular and rather thickly setose.

Type.—Cecid. a3052, New York State collection.

LUZON, Laguna Province, Mount Maquiling, March 16, 1919, College of Agriculture accession No. 18437 (*Uichanco*).

The one female is doubtfully referred to this Chilian genus. It is recorded as having been reared from leaf galls on *Schefflera insularum* Harms. Elevation about 300 meters.

Lasioptera paniculi sp. nov.

Female.—Length, 1.5 millimeters. Antennæ extending to the base of the abdomen, sparsely haired, dark brown, with at least 10 and possibly 15 segments, the fifth with a length a little greater than its diameter, all rather thickly clothed with moderately long, curved, stout setæ. Terminal segment reduced, narrowly oval. Palpi, first segment roundly quadrate, second with a length nearly twice its diameter, third one-half longer than second, fourth a little longer and slenderer than third. Mesonotum light reddish brown. Scutellum and postscutellum yellowish. Abdomen mostly yellowish brown, wings hyaline, costa dark brown, subcosta uniting with costa before basal third, the third vein well beyond basal half, the fifth joining posterior margin at distal fourth, its branch near basal half. Halteres, coxæ, and base of femora pale yellowish; distal portion of femora, tibiæ and tarsi dark brown. Claws moderately long, stout, the pulvilli nearly as long as the claws. Ovipositor with a length about one-half that of abdomen, the terminal lobes broadly oval, sparsely setose. At base there is an irregular group of about eight stout, curved hooks.

Type.—Cecid. a3051, New York State collection.

Male.—The one specimen is apparently identical in size and

color with the female and, although it had lost its antennæ, is deemed worthy of description. Genitalia: Basal clasp segment rather long, slender; terminal clasp segment moderately short, stout; dorsal plate short, broad, deeply and rather narrowly emarginate, the lobes broad and tapering to a broadly rounded, sparsely setose apex; ventral plate long, broad, and broadly rounded apically; harpes long, slender, irregular apically.

LUZON, Laguna Province, Los Baños, January 22, 1919, College of Agriculture accession No. 18419 (*Uichanco*).

The small midges bore the following data: From panicles of *Panicum carinatum* Presl. Elevation about 50 meters. This insect is with little question undescribed and it is therefore characterized as new.

Toxomyia brideliæ sp. nov.

Female.—Length, 1.5 millimeters. Antennæ nearly as long as body, sparsely haired, light brown, of 14 segments, the fifth with the stems one-half the length of the cylindric basal enlargement, which latter has a length about two and one-half times its diameter, a sparse whorl of stout setæ, a broad subapical whorl, thicker on one surface, of stout setæ and low circumfila at the basal third and apically. Terminal segment produced, with a length over four times its diameter, and a short, stout, rudimentary fifteenth segment. Palpi, first segment roundly quadrate, second with a length twice its diameter, third one-half longer than second, slenderer, fourth a little longer than third and somewhat dilated. Mesonotum reddish brown. Scutellum yellowish brown, postscutellum dark reddish brown. Abdomen light brown. Wings hyaline, subcosta uniting with margin near basal third, the third vein just beyond apex and the fifth joining posterior margin at the distal third, its branch near the basal third. Halteres yellowish basally, yellowish brown apically. Legs mostly dark straw. Claws moderately long, strongly curved, the anterior unidentate, the pulvilli as long as the claws. Ovipositor about one-fourth the length of abdomen, the terminal lobes narrowly triangular, with a length over twice the width, the narrowly rounded apex with a few coarse setæ.

Type.—Cecid. a3049, New York State collection.

LUZON, Laguna Province, Los Baños, January 2, 1919, College of Agriculture accession No. 18146 (*Uichanco*).

Two specimens of this midge were received with the accompanying data: Gall makers on leaves of *Bridelia stipularis* (L.) Blume. Elevation about 50 meters.

Mycodiplosis spondiasi sp. nov.

Female.—Length, 0.6 millimeters. Antennæ about one-half the length of body, sparsely haired, dark reddish brown, with 14 segments, the fifth with a stem one-fourth the length of the cylindrical basal enlargement, which latter has a length two and one-half times its diameter, a sparse basal whorl of stout setæ, a subapical band of longer, curved setæ, and rather high circumfila at the basal third and apically. Terminal segment produced with a length about three times its diameter and tapering to an acute apex. Palpi, first segment subquadrate, second with a length three times its diameter, third as long as second, slenderer, fourth one-half longer than third. Mesonotum reddish brown, scutellum and postscutellum pale yellowish. Abdomen fuscous yellowish. Wings hyaline, subcosta uniting with costa near basal third, the third vein at apex of wing and the fifth at distal fourth, its branch near basal half. Halteres and coxæ pale yellowish, legs mostly dark brown. Claws rather stout, strongly curved basally, the anterior unidentate, the pulvilli about half the length of the claws. Ovipositor stout, about one-fourth the length of abdomen, the entire organ rather distinctly chitinized. Terminal lobes narrowly ovate, tapering somewhat distally and sparsely setose.

Type.—Cecid. a3053, New York State collection.

LUZON, Laguna Province, Los Baños, February 18, 1919, College of Agriculture accession No. 18491 (*C. S. Banks*).

A series of females doubtfully referred to this genus was accompanied by the following data: From *Spondias mombin* L. Elevation about 50 meters. It is uncertain from an examination of the insect whether this minute form is a gall-making or a predacious midge.

REVIEWS

The | Medical Clinics | of | North America | September, 1919, | published bi-monthly by | W. B. Saunders Company | Philadelphia and London | Paper, pp. 279–549.

The New York Number, Volume 3, No. 2, contains the following papers:

Cerebral and spinal manifestations of purpura hæmorrhagica, by Dr. Warfield T. Longcope.

Cystitis: discussion regarding its therapy, by Dr. Leo Buerger.

Common disorders of childhood, by Dr. G. R. Pisek.

The symptoms and treatment of retention of waste products in nephritis, by Dr. Herman O. Mosenthal.

Recurring meningococcic meningitis, by Drs. W. W. Herrick and A. M. Dannenberg.

The value of chemical blood examinations in diagnosis, prognosis, and treatment of some constitutional conditions, by Dr. Arthur F. Chace.

Radium therapy, by Dr. George Stuart Willis.

Cholelithiasis, by Drs. M. A. Rothschild and A. O. Wilensky.

The functional diagnosis of the heart, by Dr. Morris H. Kahn.

The ¶lint murmur, by Dr. Albert R. Lamb.

Vagotonia and sympathicotonia as aids in the diagnosis and treatment of endocrine conditions, by Dr. A. S. Blumgarten.

Physical therapy in locomotor ataxia, by Dr. Heinrich F. Wolf.

A discussion on the splenomegalies, by Dr. I. W. Held.

The | Petroleum Handbook | by | Stephen O. Andros, A. B., B. Sc., E. M. | [three lines of titles] | Chicago | The Shaw Publishing Company | 910 S. Michigan Blvd. | 1919 | 16 unnumbered pages + 1–206, illustrated; limp leather; price, $2.

FROM THE PREFACE

There are many publications which treat separately of one or more phases of the petroleum industry, but none which gives the fundamentals of each and eliminates descriptions unnecessary to a clear understanding of the various operations entailed between the location of an oil well and the distribution of refined petroleum products to the consumer. There is very little original matter in the book. The sources of compilation are numerous; they comprise the bulletins of the United States Geological Survey; the bulletins of the United States Bureau of Mines; the reports of the various State Geological Surveys,

notably those of Illinois, Kansas, and Texas; and standard text books on the subject, chief among which is the work of Bacon and Hamor.

A Manual | of | Obstetrics | by | John Cooke Hirst, M. D. | [six lines of titles] | with 216 illustrations | Philadelphia and London | W. B. Saunders Company | 1919 | Cloth, $3 net | pp. 1–516, including index.

PREFACE

This book is written as a companion to the author's Manual of Gynecology. It also presents, as far as possible on the printed page, the methods of teaching the subject he has used with satisfaction for the last twenty years. Throughout the book an effort has been made to present the subject clearly and concisely, and to avoid all unprofitable discussion. The methods of treatment and technic of operations advocated have all been tested in practice and have given satisfactory results.

The scope of the book has been rather sharply limited. A minimum of embryology has been included. Diseases of the newborn child are included only in so far as they occur during the puerperium. The chapters on lacerations of the birth-canal and consequences of childbirth, while differing somewhat in scope, are necessarily very similar to the same chapters in the Manual of Gynecology.

A new classification of deformities of the pelvis is presented, classifying them according to their most prominent deformity. This method has been found easier for the student to remember, and simplifies the discussion of their management.

Especial care has been given to the description of the mechanism of labor, with a view to simplifying this, to the student, most puzzling subject. The illustrations in this chapter have been chosen with the idea of enabling him to visualize the different presentations, a thing most essential in the proper application of forceps.

The longest chapter is that on the obstetric operations. Especial care has been given to a somewhat extensive description of that most dangerous of all obstetric instruments, the forceps. The different operations are all detailed, with indications, contraindications and the steps of their performance.

The entire subject of obstetric hemorrhage is to be found in one chapter, with precise directions as to management.

This book, like the Manual of Gynecology, is presented with the hope that it will be found useful by both medical student and practitioner, whose time for voluminous reading is limited.

Commercial Research | An Outline of Working Principles | by | C. S. Duncan, Ph. D. | [three lines of titles] | New York | The Macmillan Company | 1919 | Cloth, pp. i–ix + 1–385.

FROM THE PREFACE

The theory of this book can be simply stated; it falls readily into a series of propositions which have guided the writer from first to last in the composition:

1. The immediate and primary need of business to-day is intelligent direction and control, individually, generally.
2. Intelligent direction and control of business can be had only by a better knowledge of business principles.
3. A better knowledge of business principles can be derived only from a careful and comprehensive survey of business facts.
4. To secure a careful and comprehensive survey of business facts is a problem for business research.
5. Therefore, the immediate and primary need of business to-day can be met only by business research.

This means, also, that the research work so well begun in the field of production should be carried over into trade, into buying and selling. The beginning and the end of every business enterprise is a marketing problem. The problems of marketing, therefore, like factory problems, must be isolated, abstracted, analyzed after the scientific method. More deliberate, concentrated, prolonged and undisturbed thinking ought to be applied to business problems. They are of vital importance to success; they are fascinatingly interesting in themselves; their very difficult complexity is a stimulating intellectual challenge; the rewards which their correct solution offers have no determinable limit.

Syphilis | A Treatise on Etiology, Pathology, | Diagnosis, Prognosis, Prophylaxis, | and Treatment | by | Henry H. Hazen, A. B., M. D. | [ten lines of titles] | with 160 illustrations including 16 figures | in colors | St. Louis | C. V. Mosby Company | 1919 | Cloth, pp. 7–647 including index, $6.00.

FROM THE PREFACE

At the present time there exists no small book that covers the whole field of syphilis in an authoritative way. To know syphilis means to know the entire domain of medicine, and for any one man this is impossible. In the preparation of this work I have been fortunate in being able to induce various men to write special chapters for me. Many other friends and acquaintances have aided in various ways, either with illus-

trations or advice, and to them I give my thanks, for much of the best in this book is due to others.

The Woman | of Forty | by | Edith B. Lowry, M. D. | Author of "Herself," "Himself," etc. | Chicago | Forbes & Company | 1919 | Cloth, pp. i–viii + 9–203 including index.

Modern Surgery | general and operative | by | John Chalmers Da Costa, M. D., LL. D., F. A. C. S. | [ten lines of titles] | eighth edition, revised, enlarged, and reset | with 1,177 illustrations, some of them in colors | Philadelphia and London | W. B. Saunders Company | 1919 | Cloth, pp. 11–1697 including index.

A Text-book | upon the | Pathogenic Bacteria | and Protozoa | for students of medicine and physicians | by | Joseph McFarland, M. D., Sc. D. | [two lines of titles] | Ninth edition, revised | with 330 illustrations | a number in colors | Philadelphia and London | W. B. Saunders Company | 1919 | Cloth, 1–858 pp. including index.

CONTENTS

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